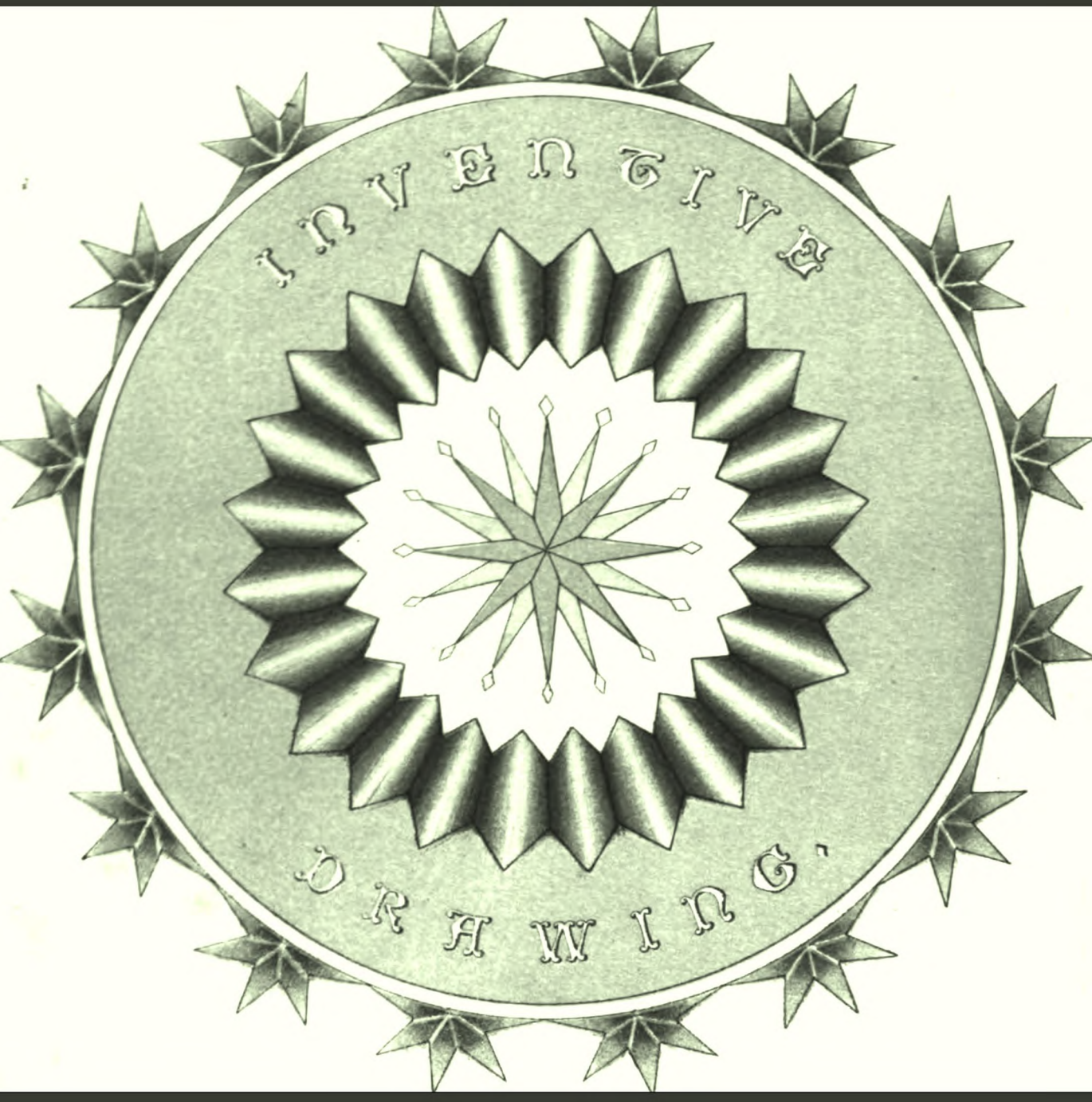
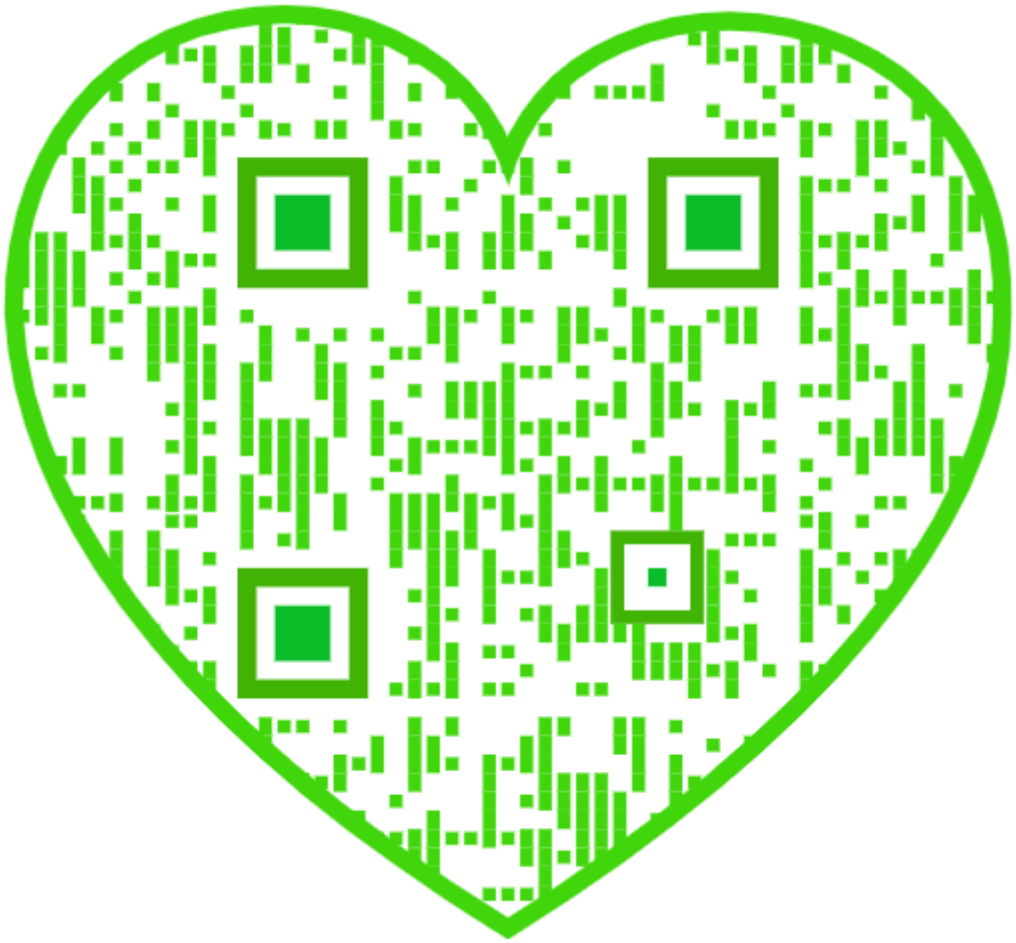


Inventive Drawing

Edward Ball



INVENTIVE DRAWING.

INVENTIVE
DRAWING.

INVENTIVE DRAWING:

A PRACTICAL DEVELOPEMENT OF ELEMENTARY DESIGN

BY

EDWARD BALL.

BIBLIOTECA CENTRAL MEXICO

LONDON.
ROBERT HARDWICKE.
192 PICCADILLY.

1864.

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PREFACE.

IN presenting this little book to the public, I wish to say one or two words as to its origin.

In 1850, the first part of a work on this subject was issued with the following title:—"A progressive Course of Inventive Drawing, on the principles of Pestalozzi, &c., by Hermann Krüsi, Teacher at the Home and Colonial Normal Schools, and Wm. J. Whitaker, Teacher of Drawing."* The second part was never published.

In the early part of 1851 I became acquainted with Mr. Whitaker, when he brought the subject under my notice, and, before leaving England, elicited from me a promise to develope this method of teaching design more fully and systematically than had yet been done. He was to render me some practical help, but found that his educational labours in his adopted country left him no leisure so to do; else would the present work have been so much the more complete and valuable.

It must be borne in mind that the greater part of the illustrations have been selected from a number of original designs executed by the pupils of a large public school, as a part only of their regular studies—that these pupils were mostly under twelve years old (some of them not more than nine) and completely ignorant of drawing or design when they first entered the school; and yet many of them are now engaged in professions which would have been closed to them but for the knowledge they had acquired from the lessons given during the few years they remained at school.

There is a notion prevalent that the power to design is limited to the skilful draughtsman. This may be true in the higher branches of art, but certainly not in the more elementary stages. Indeed, from the experience I have had with boys, it seems that the best possible beginning in Art education is with the rudiments of design. The inventive faculties of the pupil are brought into play,

* London: W. F. Ramsay, 11, Brompton Row; Ward and Co., Paternoster Row.

and he gains greater confidence for future efforts when he finds himself able to produce something which he may call his own, and which is not due to any mere power of imitation. This method of teaching is so simple that, though this book is intended as a manual for teachers, it may be used for self-instruction. A mother with the smallest confidence in her own powers—though unable to draw—may readily instruct her children, and will herself find pleasure in their progress.

It is something to induce the young to take pleasure in their studies—to make that a delight to them which before was pain—and thus lead them imperceptibly to their own intellectual advancement and welfare. If this should be my lot in the slightest degree, I shall indeed be well repaid for whatever labour this little book has cost me.

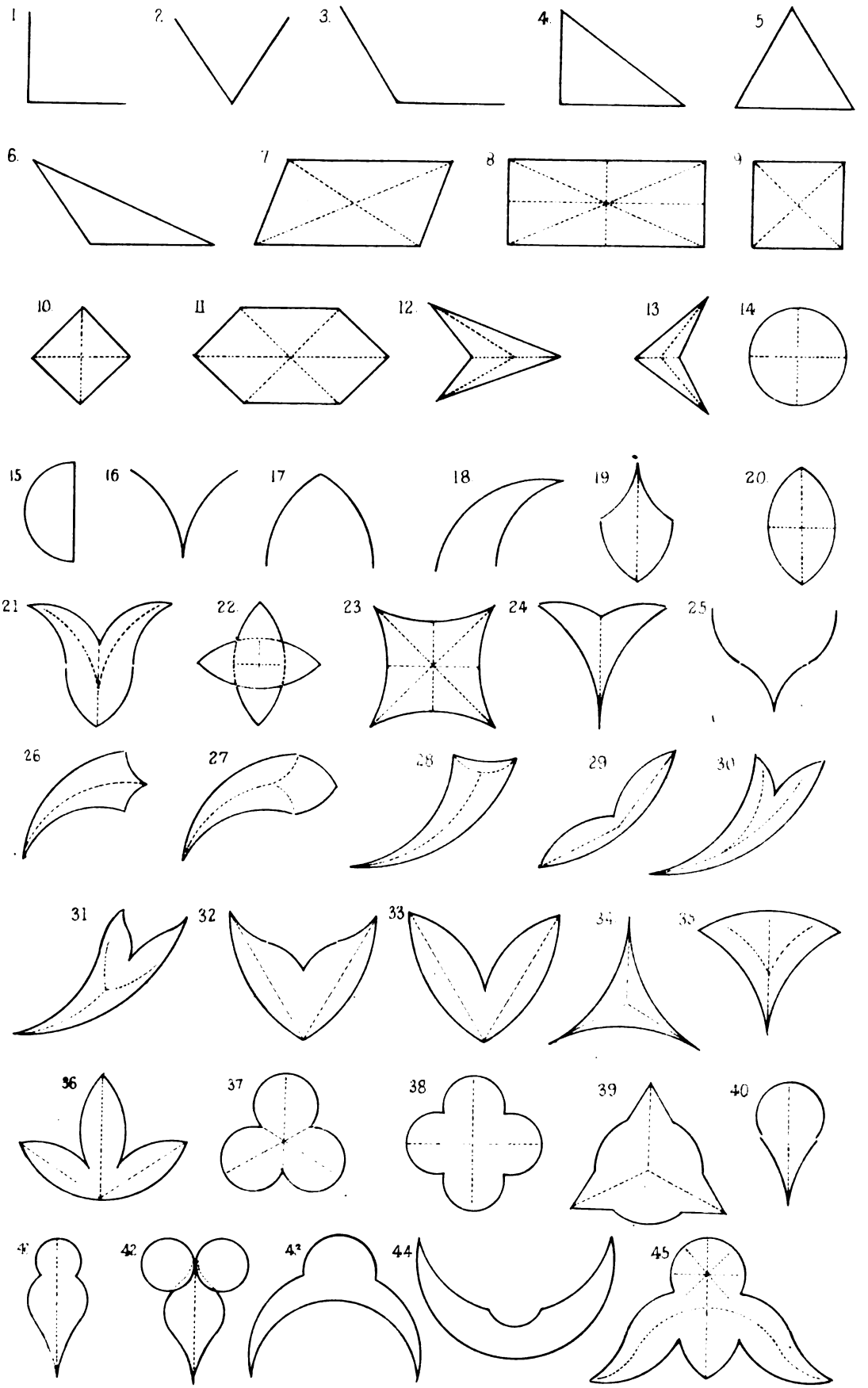
The following extracts from the life of Johannes Buss, in Barnard's *Pestalozzi and Pestalozzianism*,* will sufficiently indicate the origin of Inventive Drawing. I believe the subject was first introduced in England by Hermann Krüsi, son of one of Pestalozzi's most successful assistants, and then reduced into a form for publication by Mr. Whitaker.

"With all the attention and zeal I brought to the subject, I could not understand the peculiar view which Pestalozzi took of drawing, and I could not at all make out his meaning when he told me that lines, angles, and curves were the basis of drawing. * * * He said, it must be done by dividing the square and the curve, by distinguishing their simple elements and comparing them with each other."—p. 199.

"Experience confirms the conjecture which I had formed that children taught upon this method would make more accurate distinctions than even men accustomed, from early life, to measuring and drawing; and the progress which many of our children made was beyond comparison greater than that which is commonly obtained in schools."—p. 201.

In the following pages I have addressed myself mainly to the teacher, but the remarks will equally apply to those who desire to become their own instructors, as I have taken it for granted that those whom I address are entirely ignorant of Drawing or Design.

* New York: Brownell, Appleton's Buildings.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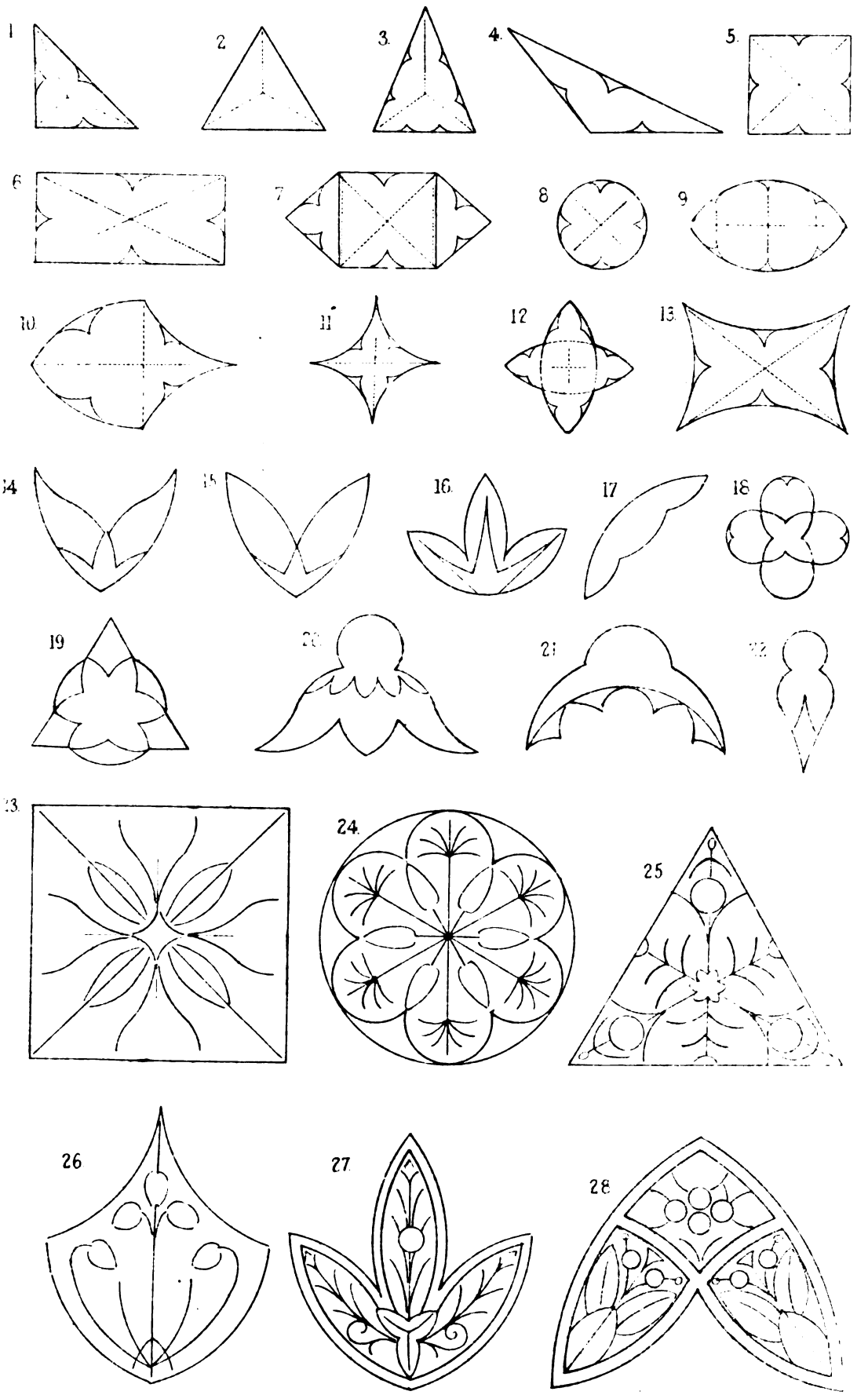
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PART I.

COMBINATIONS OF RECTILINEAL ANGLES.

Plate.		Lesson.
1	Elementary and compound forms used in the "Combinations."	
2	Elementary and compound forms used in the "Combinations," together with skeleton forms of "Designs from Nature."	
3	Combinations of four right angles, ...Nos. 1 to 3 inclusive	1
	„ „ „ acute angles, ... 4 to 6 „	2
	„ „ „ obtuse angles,..... 7 to 9 „	3
	„ „ „ right and four acute angles ... 10 to 12 „	4
4	„ „ „ right and four obtuse angles ... 1 to 3 „	5
	„ „ „ acute „ „ „ „ ... 4 to 6 „	6
	„ „ „ right, four acute, and four obtuse angles ... 7 to 12 „	7 8
5	„ „ six right and six acute angles ..... 1 to 3 „	9
	„ „ „ „ „ „ obtuse angles..... 4 to 6 „	10
	„ „ „ acute „ „ „ „ ..... 7 to 12 „	11

To use this book with any degree of success, it is essential to have a clear understanding of the definitions and of the things defined. The teacher, therefore, in bringing this subject under the notice of his pupils, will strive to be as plain and simple as possible in his language—always with a regard to accuracy—and as much to the purpose, in his illustrations, as he well can. It is best to obtain, if possible, a definition from the pupils themselves, by a series of well-considered questions, calculated to make them think before venturing upon an answer, and at the same time to make sure they have a complete knowledge of the thing rather than some special feature only. Whatever brings into play the mental powers must of necessity be more abiding than that which is gained with-

out energy. I am aware of the labour this method will entail upon the teacher; but I am sure that, whatever time and patience it may cost in the beginning, the end will amply repay. The pupil will feel his progress to be more certain, and will have greater confidence in himself, when he finds he has gained a power he lacked before—that of giving a full and satisfactory reply to any question put to him. The mental effort required to compare things, and even to weigh well the words he uses before giving utterance to them, is a discipline not to be despised. Children should be taught to depend on their own powers of thought and action. Intelligent utterance will of necessity follow. The teacher should put the same question many ways, and should always be ready to believe that whatever failure may follow his efforts lies more in himself than in the pupil. He may have used an unhappy expression, or a *word* only with which the pupil is not familiar. The unsuccessful result may be owing to no unwillingness or want of ability on the part of the scholar. The teacher often fails by being over anxious that his pupils should make rapid strides at first, and gets discouraged when he finds them apparently slow of apprehension. A slow and sure beginning will make a quick and certain end. Persistence and industry will be a match for any amount of obtuseness. The least sign of a desire on the part of the pupil to profit by the teacher's labours, should be accepted as a hopeful promise for the end.

The definitions in this work are given mostly in their strictest mathematical form. These, of course, should not be given to the pupils at first, if they are very young, but much simpler ones substituted. Whatever is given to them should be thoroughly mastered. Get them to understand the distinction between a mathematical line, which has length but not breadth, and a line which is drawn by the pencil or chalk, and which necessarily has both.

For the study of the first part of this book, it will be quite sufficient to make the pupils understand what a straight line is, the differences between perpendicular, horizontal, and oblique lines; and from these the composition of right, acute, and obtuse angles. The more illustrations are given upon the black board the better. In teaching the "combinations" it would perhaps be advisable to take one of the examples of the combining of four right angles—

Plate I., Nos. 1 to 3: Draw on the black board one of them, thus: then add a second, so: then the third: then the fourth, when the first example on Plate I. will be complete: Then let the pupils try; but impress upon them the necessity of observing this rule—*no line must cross another.* This will be necessary in the lessons classed as "combinations." See, also, that the divisions between the angles are kept very distinct. Allow no design to pass where the proper number of angles is not given. The same number as adopted in this work need not be adhered to; the teacher must exercise his own judgement. The slate will be found the best for the early lessons, a mistake or a badly-drawn line is so easily rectified. Let the pupil follow the same method as the teacher—namely, draw one angle first, another when told to do so, then a third; see, then, if there is any chance of the combination, when completed, possessing anything like symmetry; if so, allow the pupil to proceed; if not, a *little* suggestion may be judicious. I have always found it best not to suggest, if there is the slightest chance of the pupil progressing without. His first attempt may be a hopeless jumble: never mind—courage and chalk are the teacher's best friends.

We will suppose a boy to begin by placing his first angle so, his second in the oddest place imaginable, ; he perhaps cannot proceed; put the third for him in any way you think will give him some chance of finding the end for himself, say , or ; this help may be of service to him.

It would perhaps be well if only one figure were used at first, the teacher giving the first three angles upon the black board, and allowing the pupils to finish the figure in their own fashion; the number of angles given may then be reduced to two, then one. Take this for instance, , the pupil may complete it thus, or , ro , or a hundred different ways.

If there is much difficulty at the beginning, cut out some angles

of paper or card-board, and let the pupils place them, and then draw what they have symmetrically arranged.

When the pupil has produced a really good design, he should be allowed to copy it about eight times the size of those on Plate III. This will give him good practice in Free-Hand Drawing. No measuring should be resorted to—the *eye* is the sole instrument that should be allowed for that purpose.

If these instructions are faithfully followed, the teacher will find that, in a very short time, the pupils will not only advance rapidly, but with a certainty rarely obtained—he will have the satisfaction to see the work of his hands prosper in an unexpected degree.

The list of plates at the head of each part will show the natural division of lessons, each "combination" being equal to one. When the pupils advance rapidly, two or three lessons may be compressed into one; but all scholars should be expected to produce, at least, a dozen examples of each combination.

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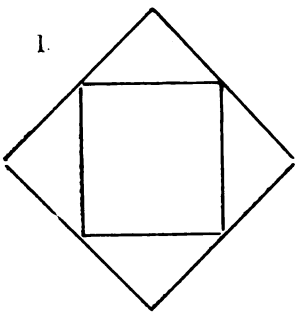

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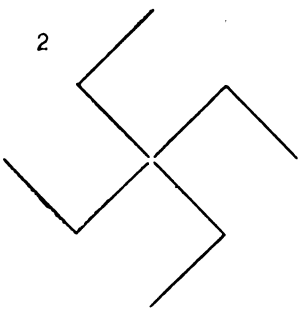

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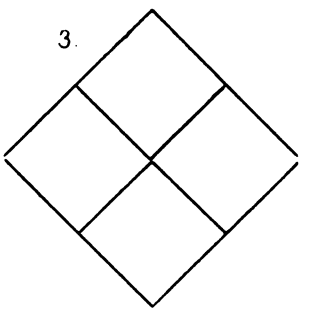

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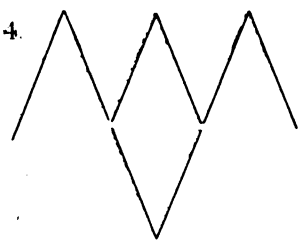

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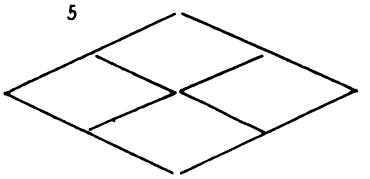

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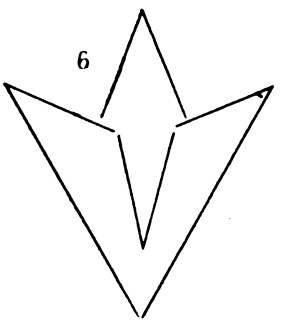

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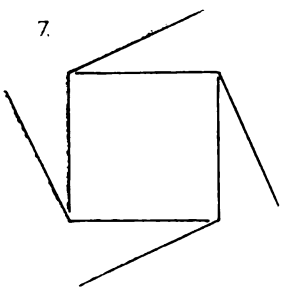

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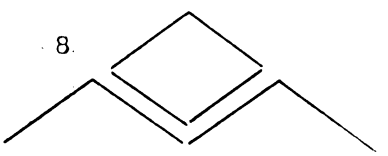

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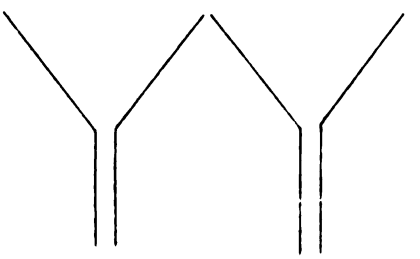

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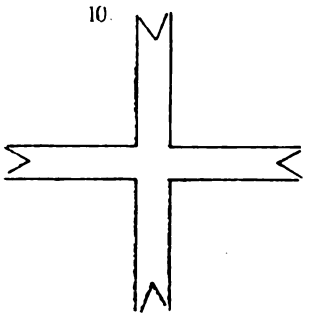

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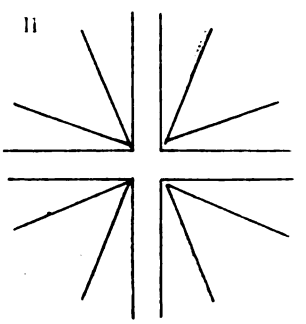

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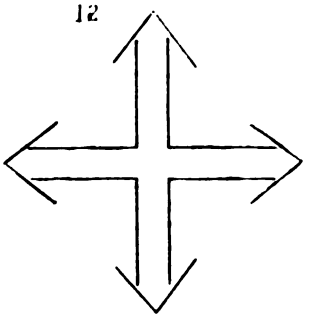

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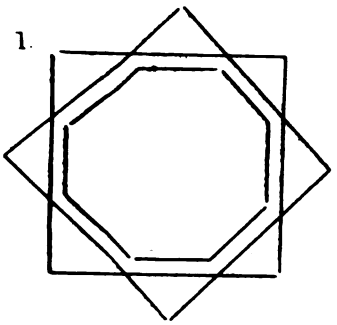

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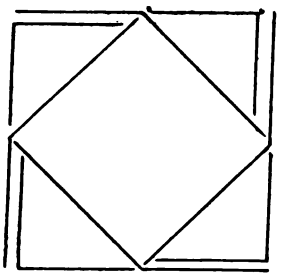

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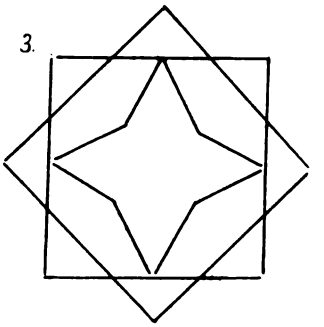

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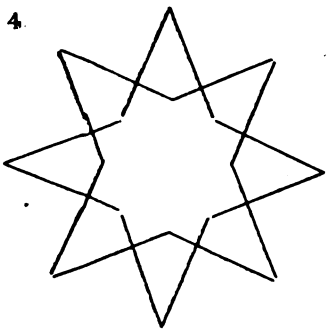

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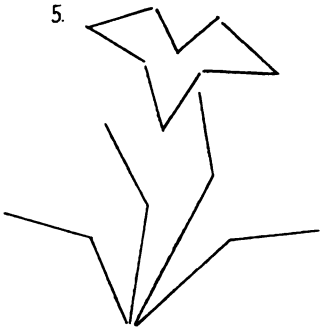

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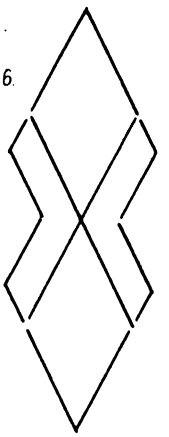

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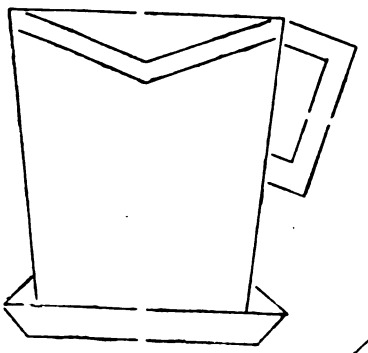

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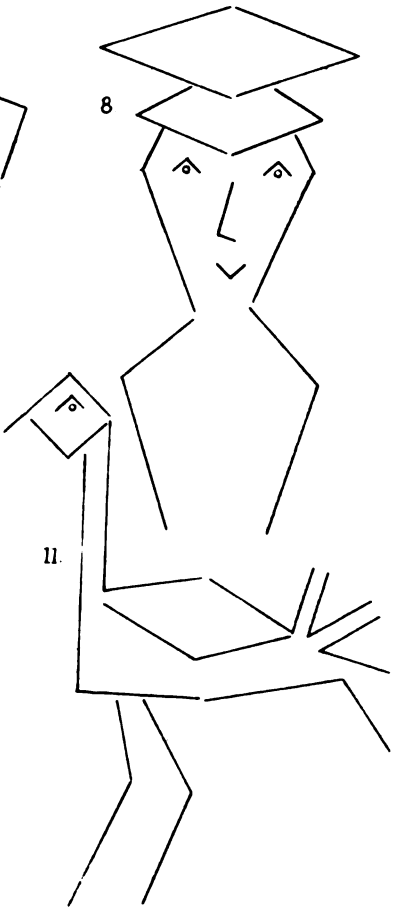

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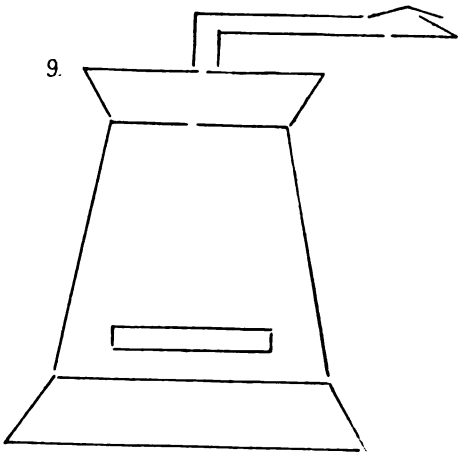

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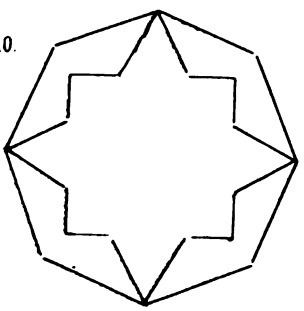

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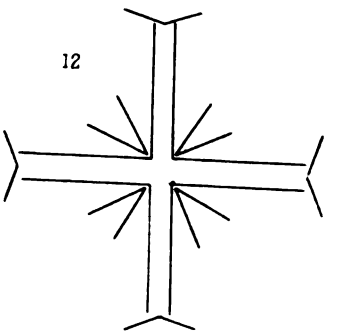

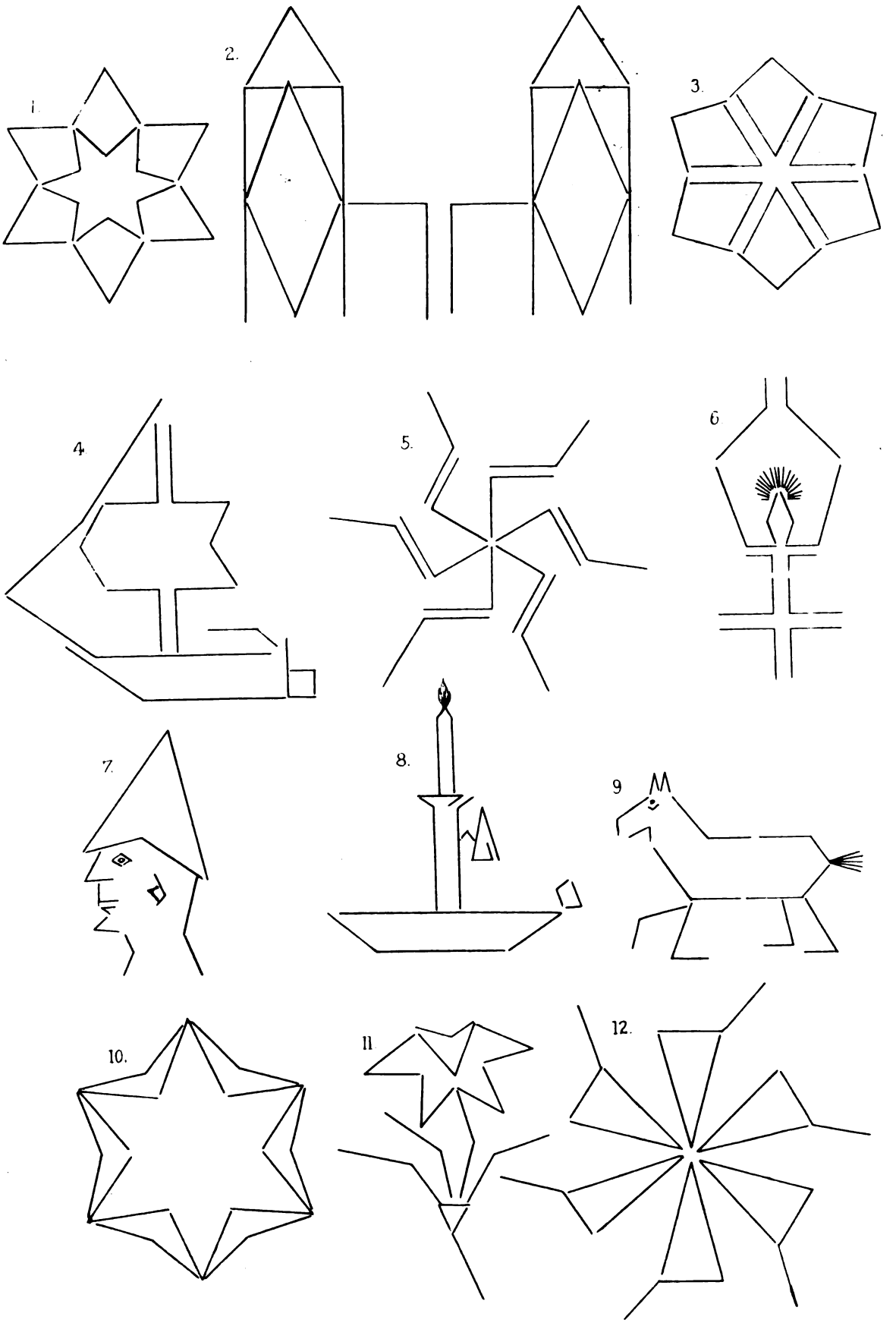
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PART II.

PART II.

COMBINATIONS OF TRIANGLES.

Plate.			Lesson.
6	Combinations of four right-angled triangles, ...	Nos. 1 to 3 inclusive,	12
	„ „ „ acute „ „	4 to 6 „	13
	„ „ „ obtuse „ „	7 to 9 „	14
	„ „ „ right, four acute, and four obtuse-angled triangles...	10 to 12 „	15
7	Combinations of any number of triangles	1 to 3 „	16

What has already been said on the "combinations" of angles is equally applicable to triangles. Two, three, or more may be combined to form one design, either of right, acute, or obtuse-angled triangles; or, indeed, of any number of them mixed.

I have not thought it advisable to multiply the number of sheets of this part of the work by giving many illustrations, as so many have been given of Part I. that this would be but a repetition.

It will be seen that No. 6, Plate 6, is a deviation from the rule laid down in Part I., that no lines should cross each other. There is, also, a slight error in No. 1 on the same sheet: the two inner perpendiculars should have been omitted; they are superfluous, and were drawn by mistake.

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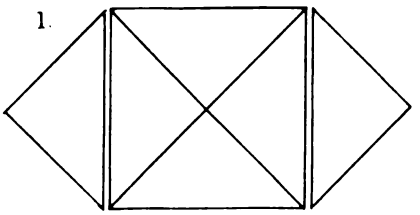

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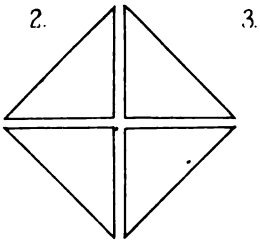

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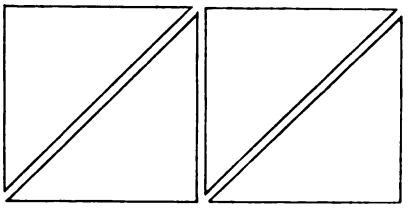

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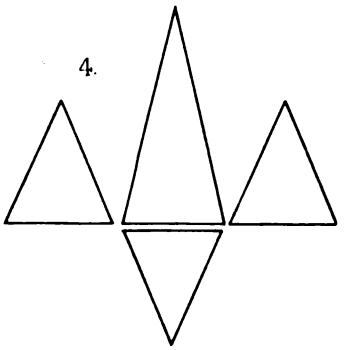

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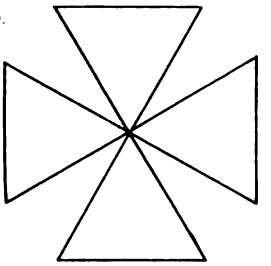

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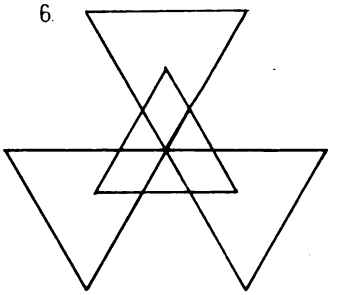

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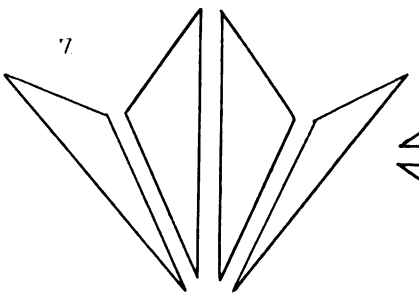

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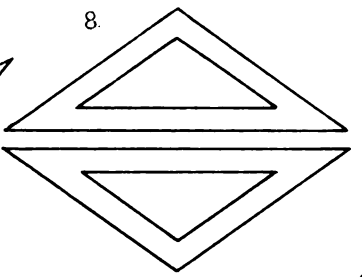

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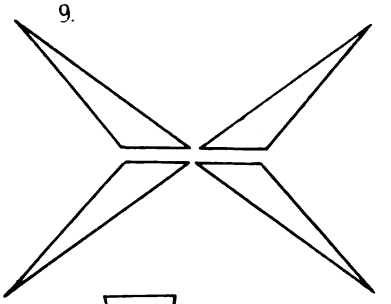

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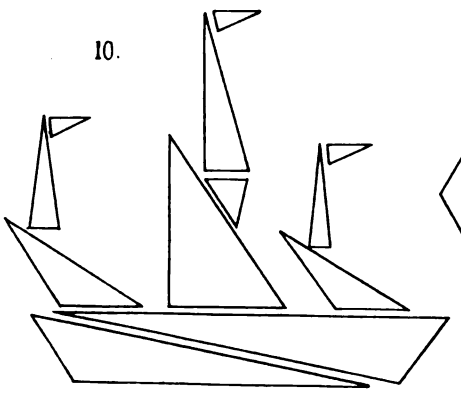

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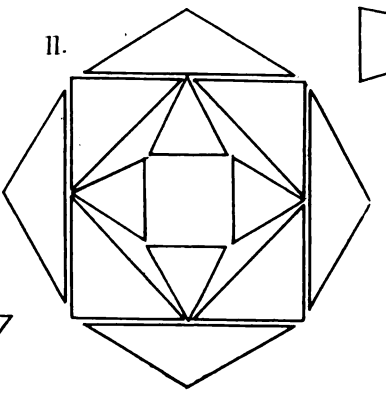

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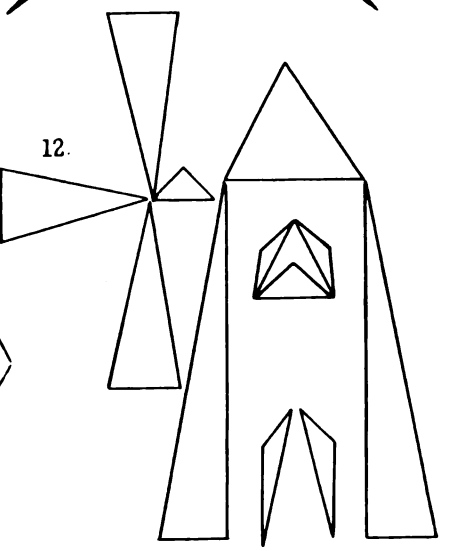

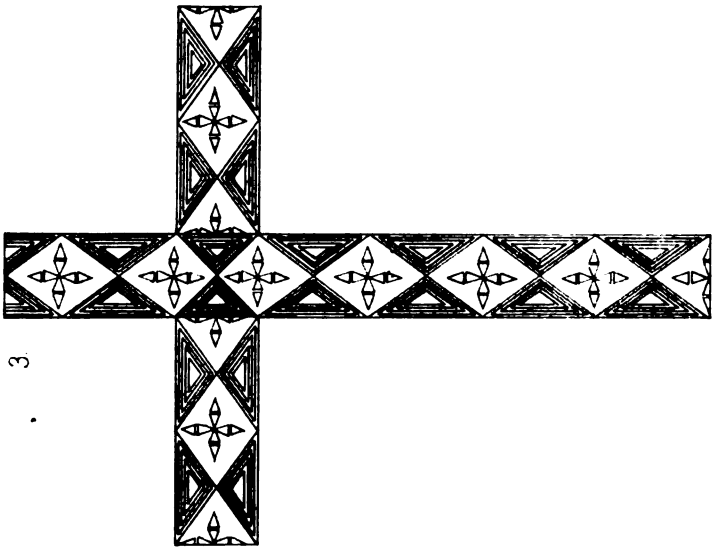

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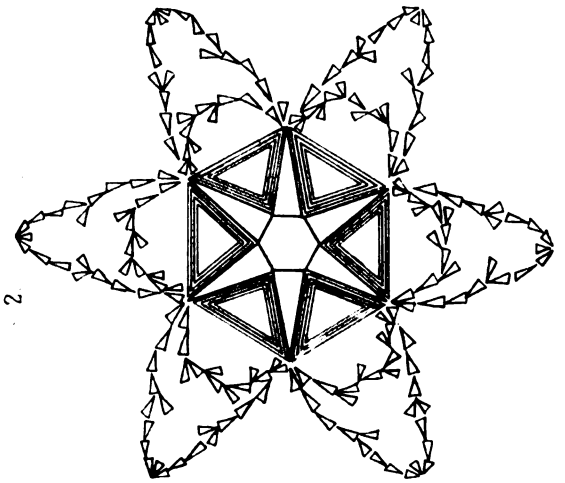

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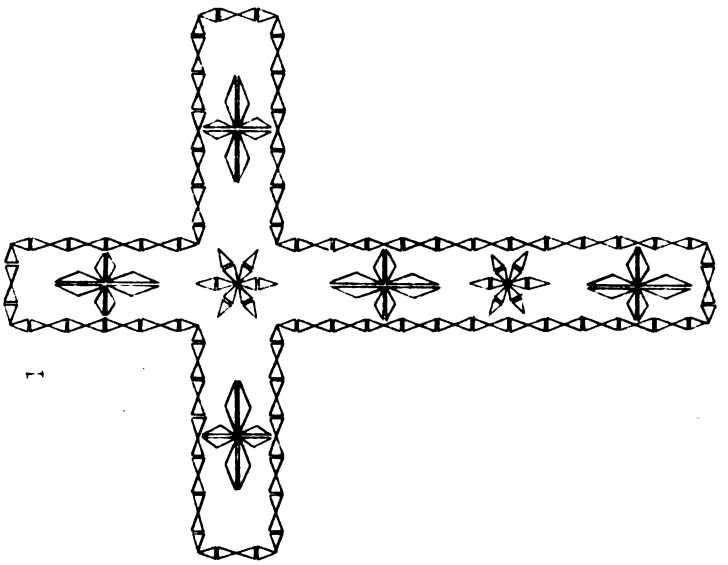

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PART III.

PART III.

COMBINATIONS OF THREE AND FOUR-SIDED FIGURES.

Plate.		Lesson.
8	Combinations of any number of three and four-sided figures, Nos. 1 to 6 inclusive	17
9	Combinations of any number of three and four-sided figures, with graduated tint	18
10	Combinations of any number of three, four, and six-sided figures, with graduated tint. "Inventive Drawing,"—*Frontispiece*	„

In this part a few examples only are given of combinations of *any number* of three and four-sided figures. But the same method should be adopted as with the lessons which have gone before: namely—to combine three, four, five, or any limited number of one figure only, such as No. 7, or No. 8, and so on. The figures may be lengthened or shortened to suit any arrangement the student may find most convenient. The limitation as to the number of each form to be combined will only be necessary till the pupil feels pretty confident, and has given evidence that he can use a larger number with ease and advantage.

The use of the graduated tint will prove an interesting part of the work, and will stimulate the young to try and produce designs which will have a pleasing effect when so tinted. The teacher may encourage his pupils to work at these at home, and he will soon have a constant succession of nicely executed designs pouring in upon him. His efforts should now be directed to the improvement of what little taste the scholars under his care may show, pointing out any little defect which may appear.

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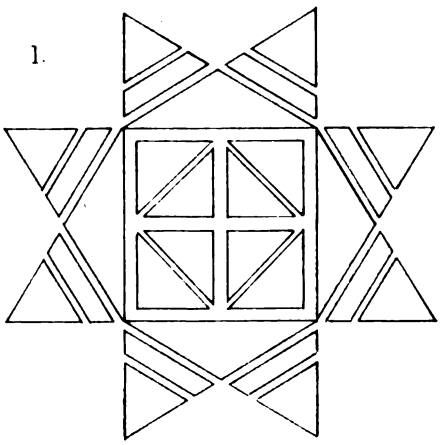

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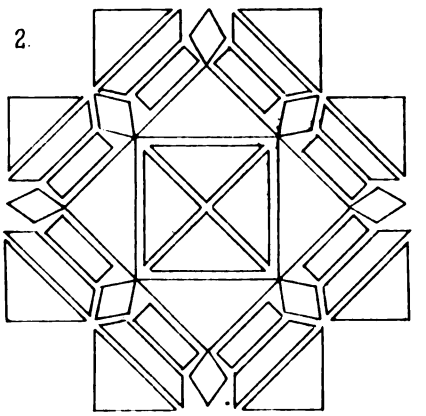

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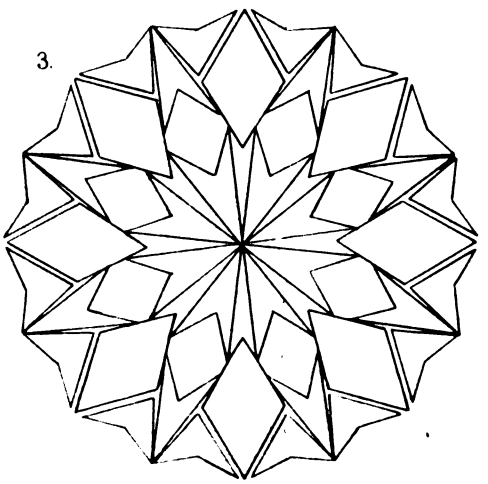

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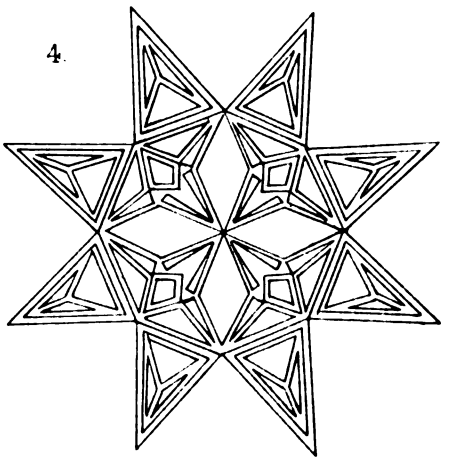

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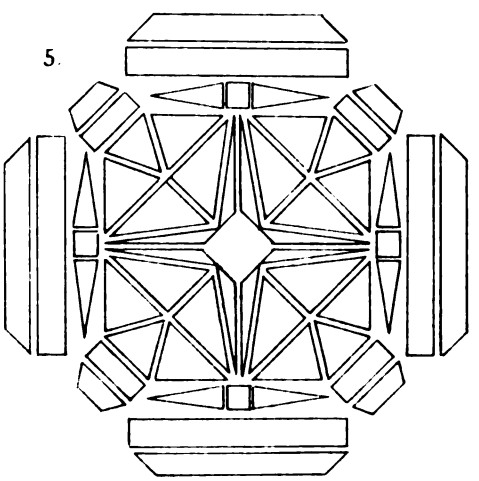

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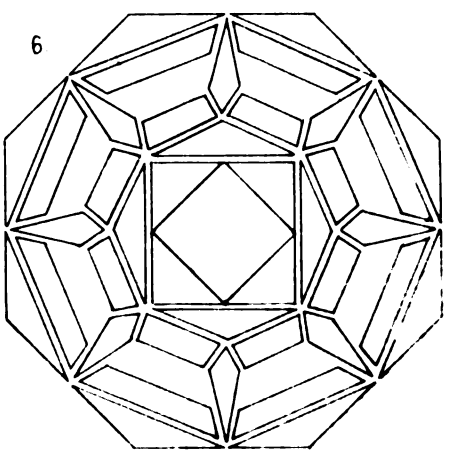
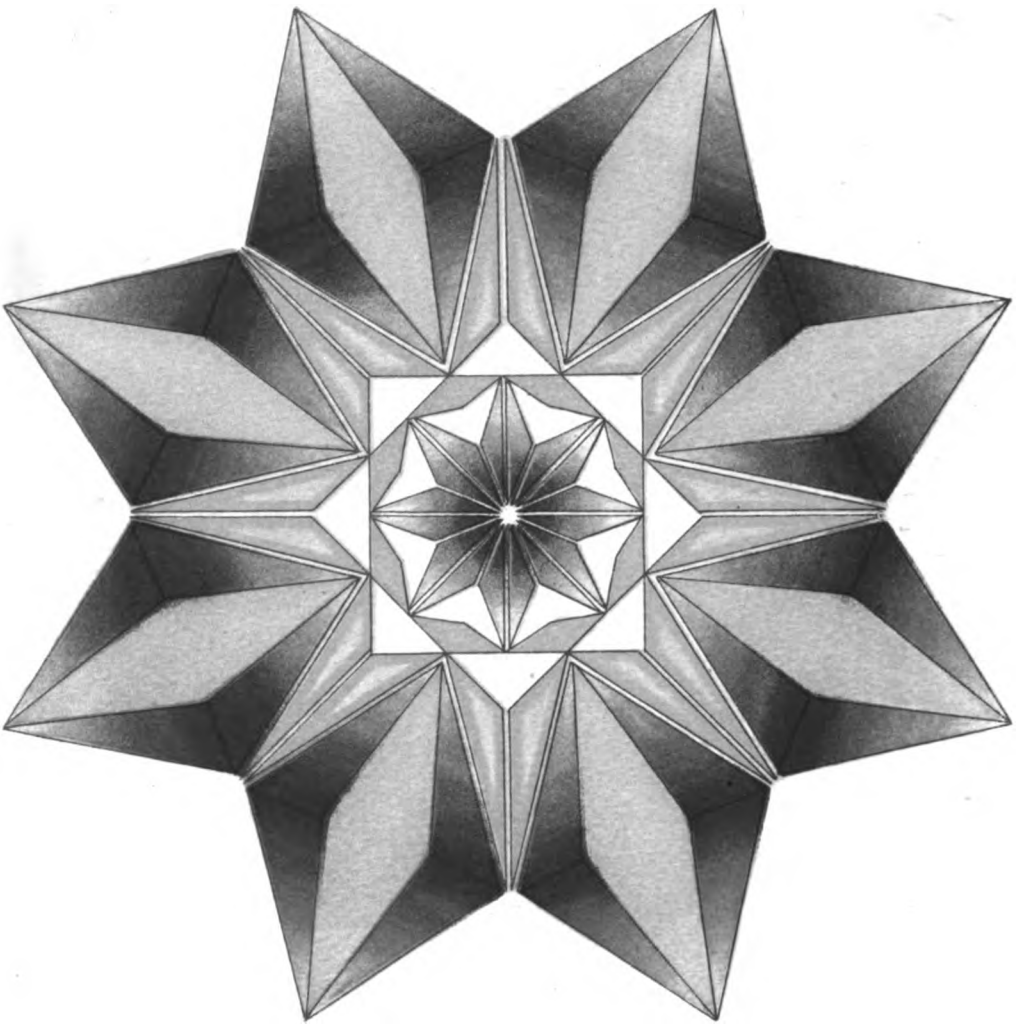




PART IV.

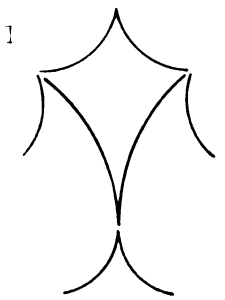
COMBINATIONS OF CURVILINEAR ANGLES AND FIGURES.

Plate.			Lesson.
11	Combinations of four convex angles	Nos. 1 to 6 inclusive	19
	„ „ „ concave „	„ 7 to 9 „	20
	„ „ „ mixed „	„ 10 to 12 „	21
12	„ „ „ convex and four concave angles	„ 1 to 6 „	22
	„ „ „ „ „ „ mixed „	„ 7 to 9 „	23
	„ „ „ concave „ „ „ „	„ 10 to 12 „	24
13	„ „ „ convex, four concave, and four mixed angles	„ 1 to 2 „	25
	„ „ „ of each of any given number of compound forms from plates 1 and 2	„ 3 to 6 „	26
14	„ „ any number of simple or compound forms from plates 1 and 2	„ 1 to 6 „	27

In this part it will be necessary to get the pupils to understand what is meant by a curvilinear angle. It will, no doubt be new to many of them, but is easy to be imparted. The clear perception of the differences of convex and concave* will readily enable them to know a convex from a concave angle, or a mixed one from either. It will then be easy to analyse the compound forms, to show how they are made up of the circle or parts of the circle, and of these three angles, which themselves are parts of a circle. Thus Nos. 16, 17, and 18* are made up of two arcs of circles. No. 19, again, is made

* See definition and note.

up of 16 and 17 ; No. 26 of Nos. 16 and 18 ; No. 27 of 17 and 18. It will be an easy matter to multiply the compound forms if more are required than are given in this work. There is little danger of a student being slow of apprehension when he has progressed thus far. Curvilinear forms are so attractive that they commend themselves to the dullest intellect. Some little liberty in altering the forms should be allowed at this stage, as by a very slight variation in the shape of one or more, the design when completed may gain considerably in symmetry or grace. Compare No. 43, plate 1, with the same form in No. 1, plate 14, in which the two ends are allowed to meet, and thus form what may be called a circle, which has placed inside it the form No. 17, plate 2. I mention this as one instance only ; many others will be found in different parts of the same sheet, as well as in other parts of the work.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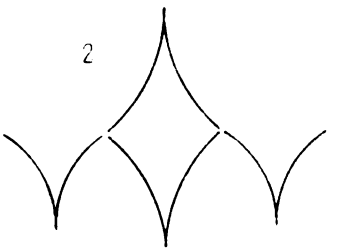
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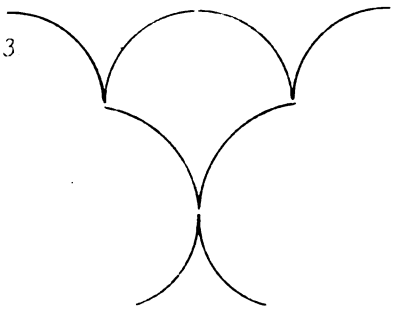
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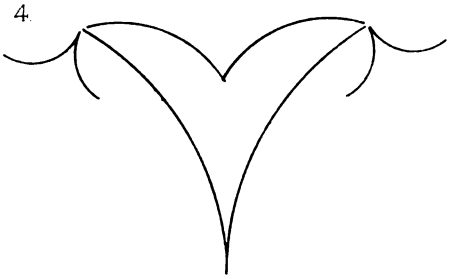
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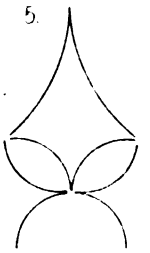
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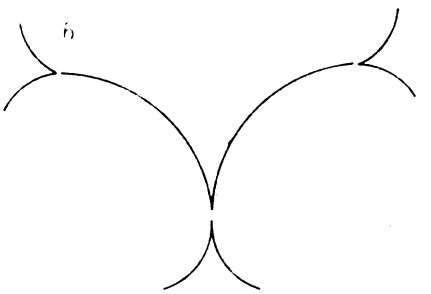
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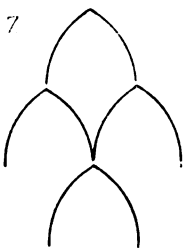
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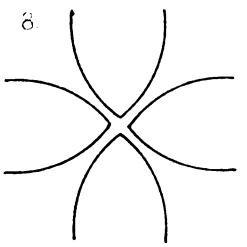
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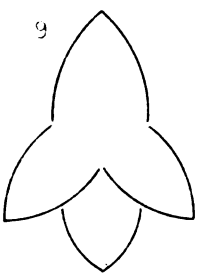
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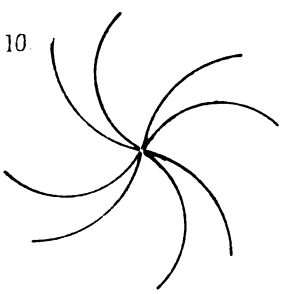
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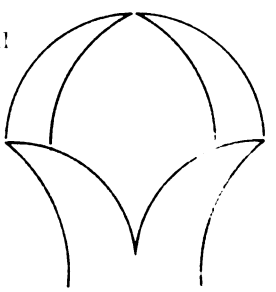
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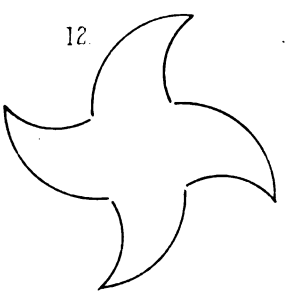
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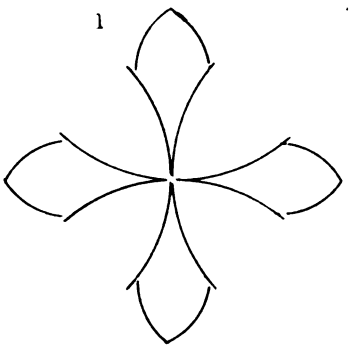

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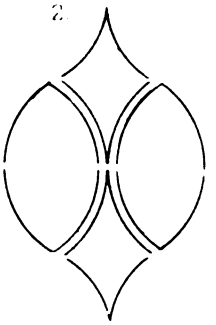

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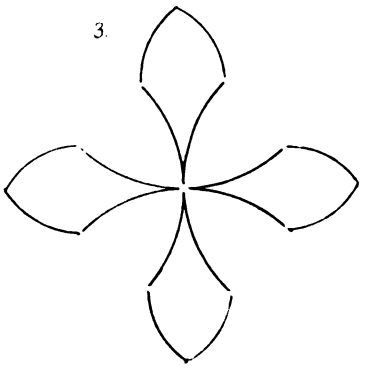

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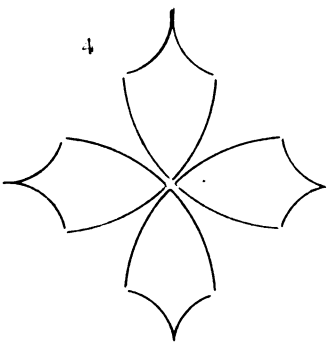

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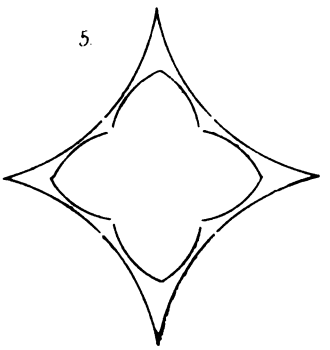

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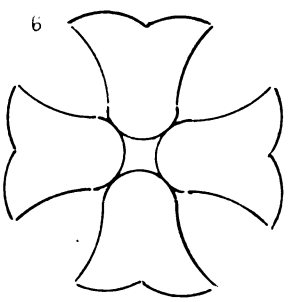

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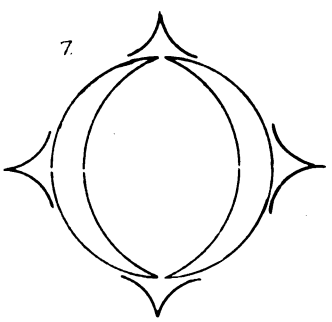

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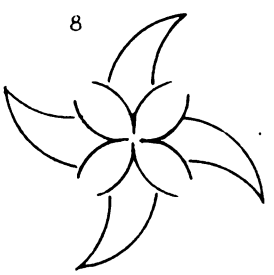

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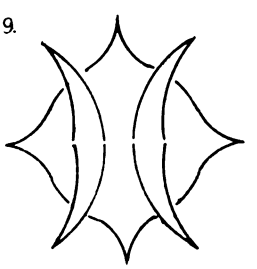

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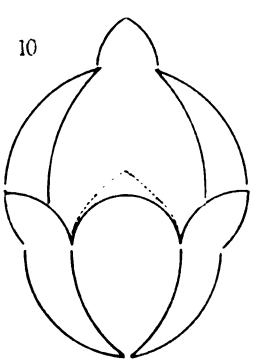

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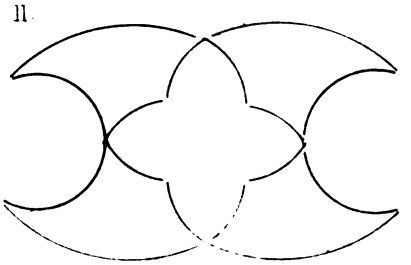

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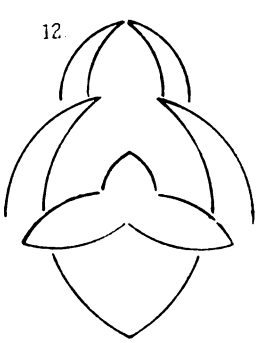

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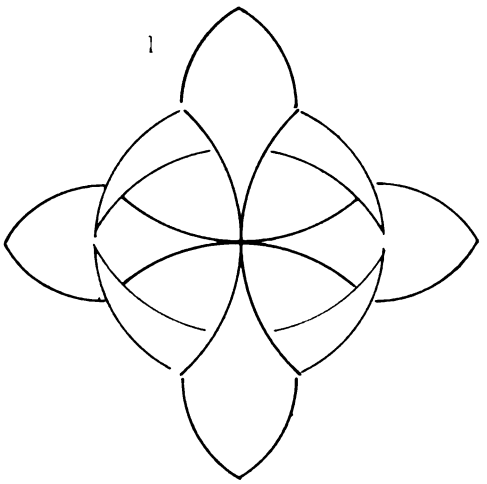

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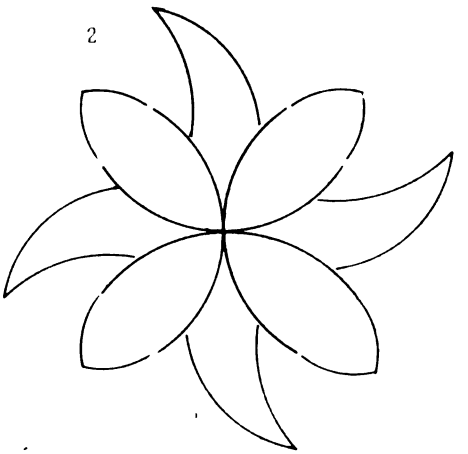

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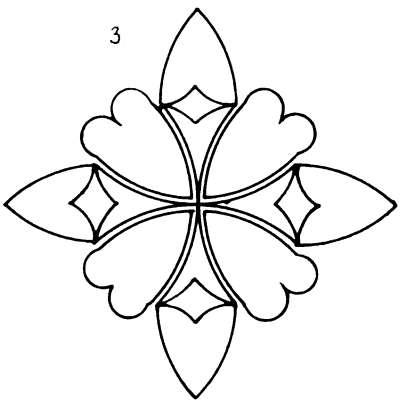

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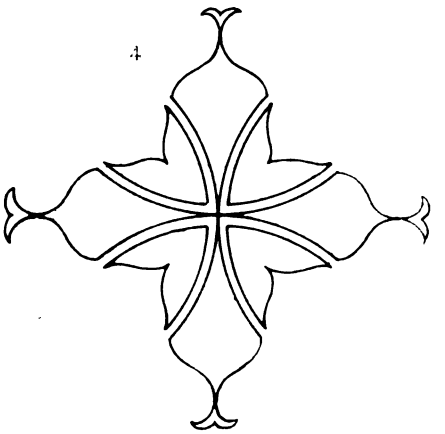

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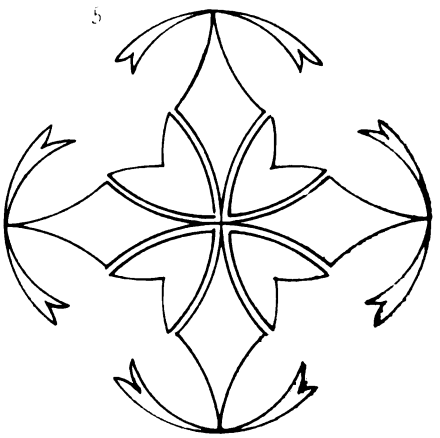

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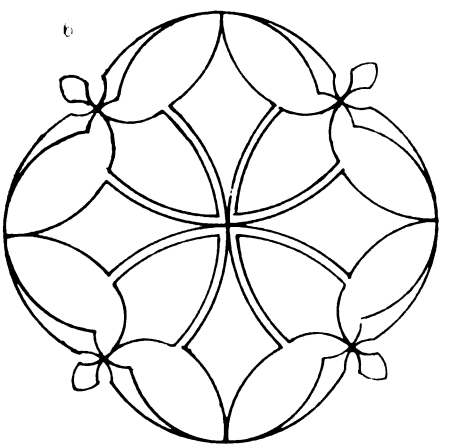

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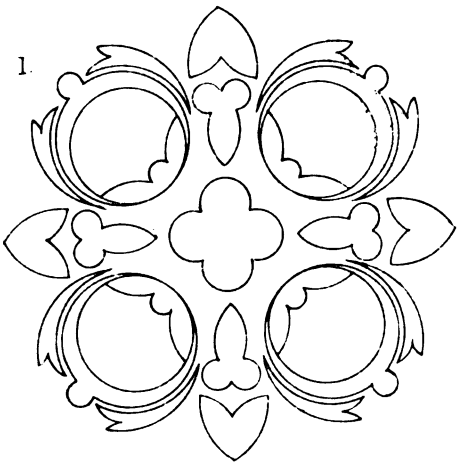

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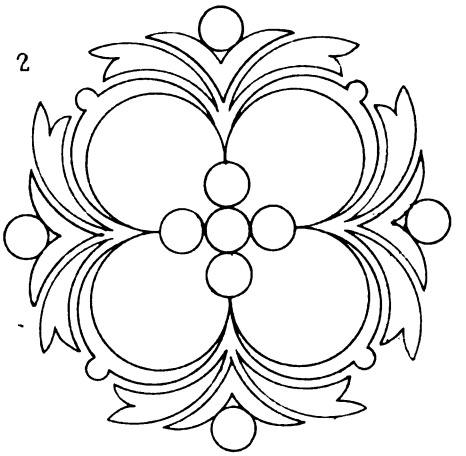

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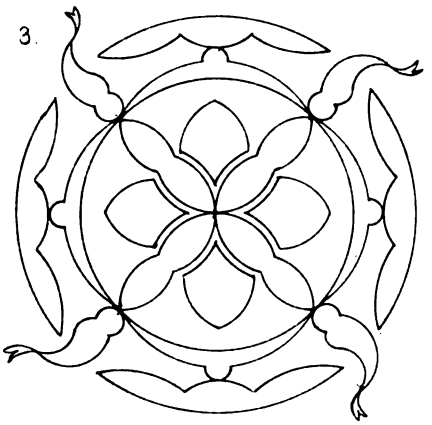

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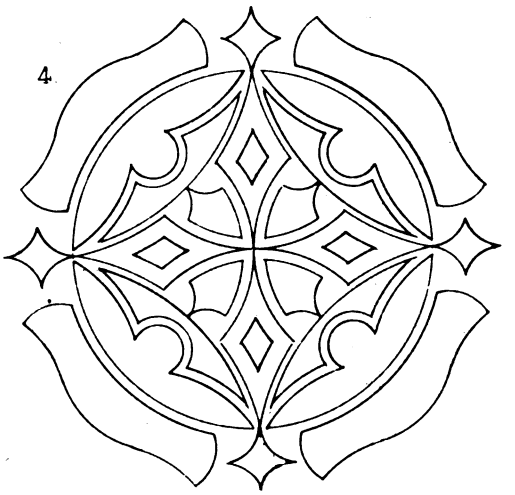

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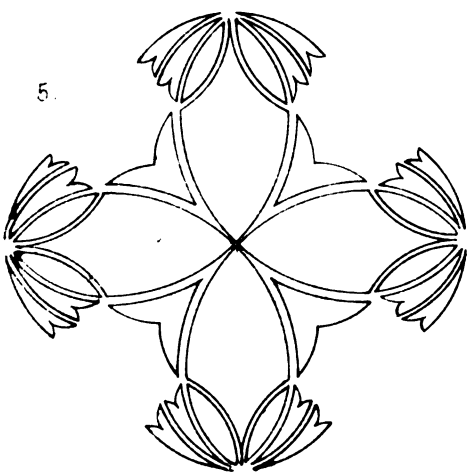

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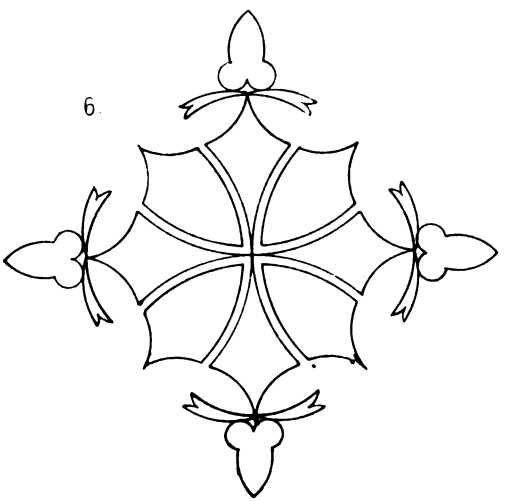

PART V.

DIVISION OF GEOMETRIC FIGURES BY RIGHT LINES.

PLATE.		LESSON.
15	Division of the square by right lines .....Nos. 1 to 6 inclusive	28
16	„ „ „ triangle „ „ „ ..... „ 1 to 6 „	29
17	„ „ „ circle „ „ „ ..... „ 1 to 6 „	30

Hitherto the lessons have been based on what may be called "a putting together:" they will now take the form of division. The simplest of regular forms, namely, the square, is chosen as the starting point. This should be divided by drawing lines which will bisect the sides; thus four smaller squares will be included in the one large one; then draw the diagonals, which will have the effect of farther sub-dividing the figure into eight triangles. The quadrilateral figure, No. 23, plate 1, is thus divided; so is No. 8, plate 1; No. 9, only partly so. But the best illustration is, perhaps, No. 1, plate 15, which is first of all divided as described above; and then the lines which bisect the sides partly rubbed out, (as indicated by the dotted lines,) and supplementary lines drawn from them to the angles of the square on each side of the diagonals. No. 3, on the same plate, is the same thing repeated with slight variations. No. 6 is, again, the same with an additional line drawn from each of the angles. The truth of this will be seen by taking the fourth part of the square only into consideration. No. 5 is, again, but an elaboration of the same principle of division. But it must not be supposed that it is essential to follow this plan only; each teacher may develope his own. The square may be divided into any number of subordinate parts, as in No. 4, (which is divided into nine

equal squares,) and these again subdivided according to the taste of the student. Nothing can be more simple or natural than this method of procedure. Each pupil may be his own instructor by a careful attention to the directions in this book. He may commence by taking any example given on the plates and draw it bit by bit, as directed, till it is completed : do the same over and over again till he has the one form firmly fixed in his memory; then try another, and so on till he finds he has power to produce forms of his own.

The same mode of treatment is applicable to the division of the triangle, as well as the square, by drawing lines from the angles which shall bisect or trisect, &c., the opposite sides; or lines may be drawn parallel to one or all sides, as starting points, at equal distances. No. 6, plate 16, is an illustration of this. No. 5 shows a bisecting line, and then lines drawn parallel to that.

In dividing the circle it will, of course, be the more natural method to let all lines radiate from the centre; but a fictitious centre may be taken, or, which is the same thing, the point which forms the real centre, and which in a practical application, like the present, must have "parts," may be expanded into a *circle*, and this taken as the starting point, taking care that the lines so drawn, if produced, would pass through the real centre. No. 6, plate 17, will show this, as no line *really* passes through the centre, though many of them tend thither. No. 4, on plate 15, and Nos. 5 and 6, plate 16, or any forms which indicate a solid, would be good examples for practice in graduated tint, in any of the colours generally used for that purpose, such as Sepia, Vandyke-brown, Indian-ink, &c.

When the student has acquired the power of producing designs applicable to manufacture, he may of course exercise himself in the use of colours. Plate 19—designs for encaustic tiles—can be so treated. Figures such as those on plates 13 and 14, together with 18, may be used for practice in the earlier lessons on complementary colours, if the teacher should feel disposed to enter upon that subject.

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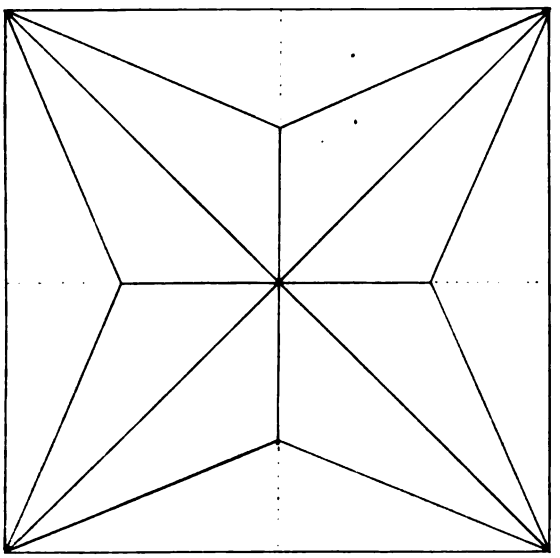

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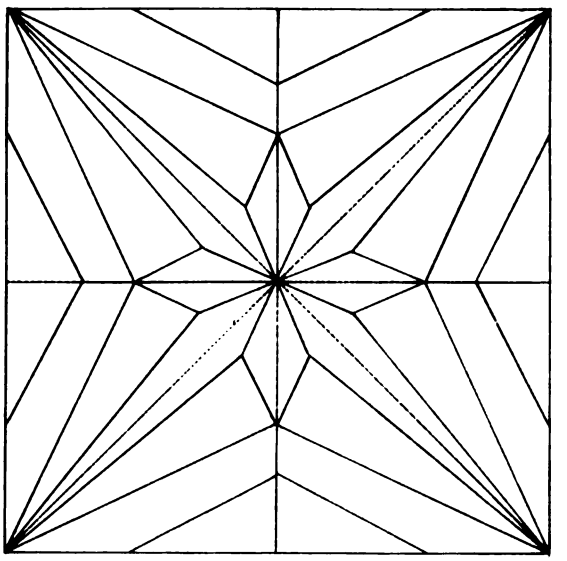

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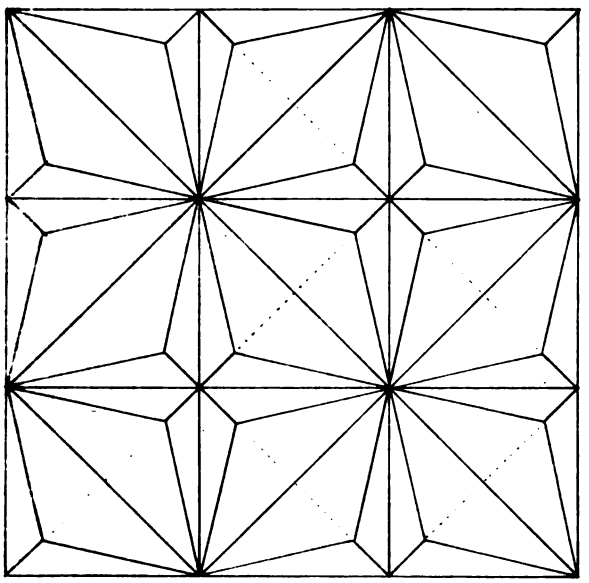

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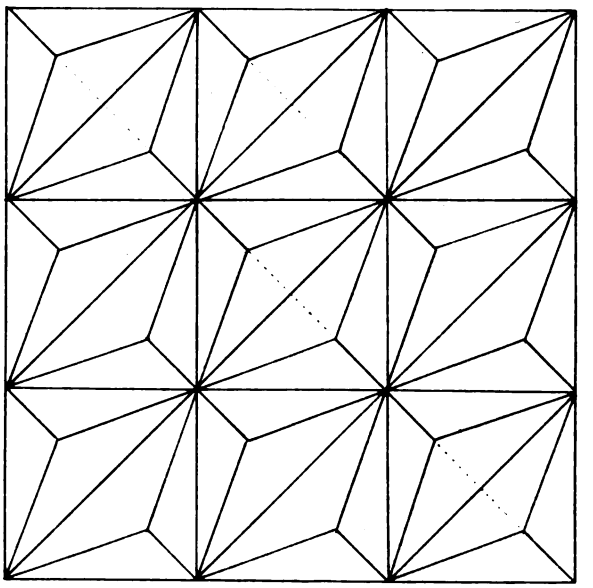

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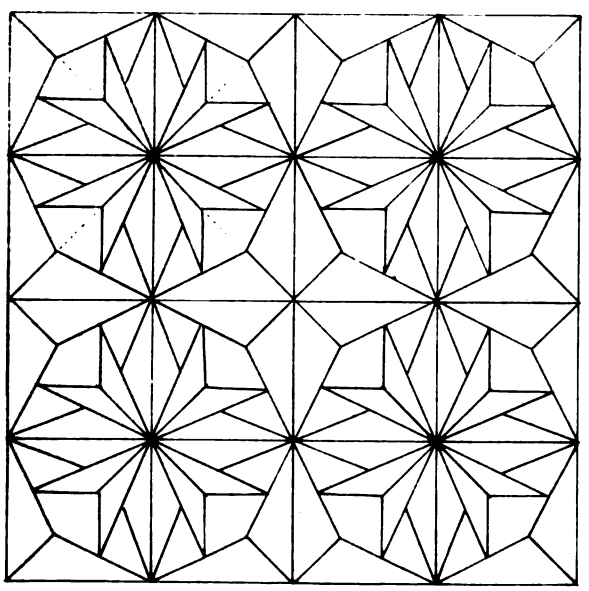

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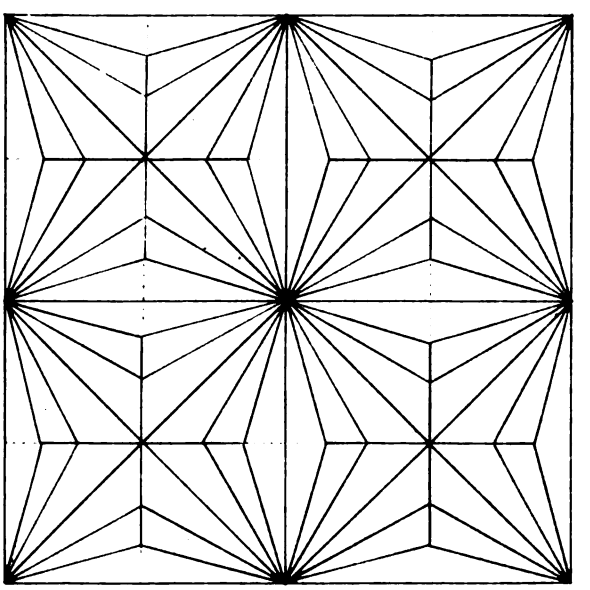

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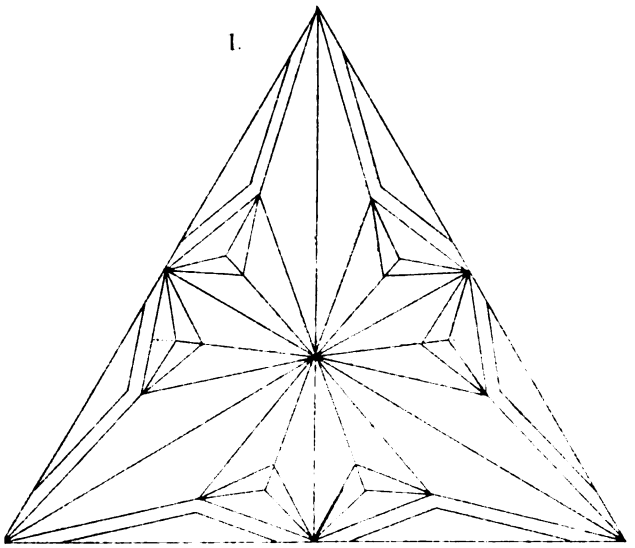

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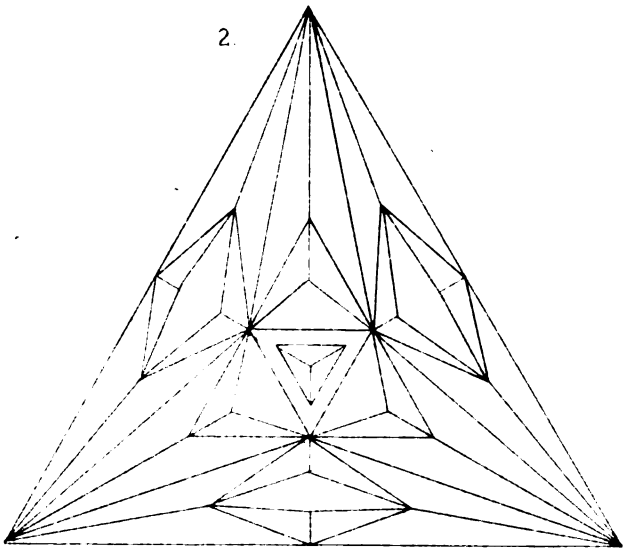

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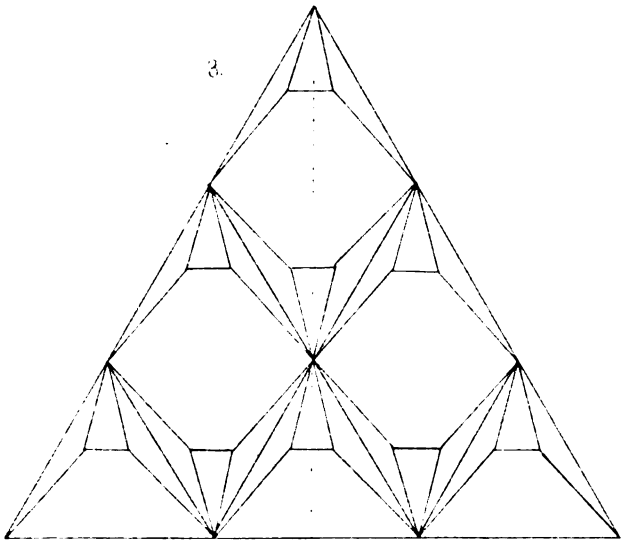

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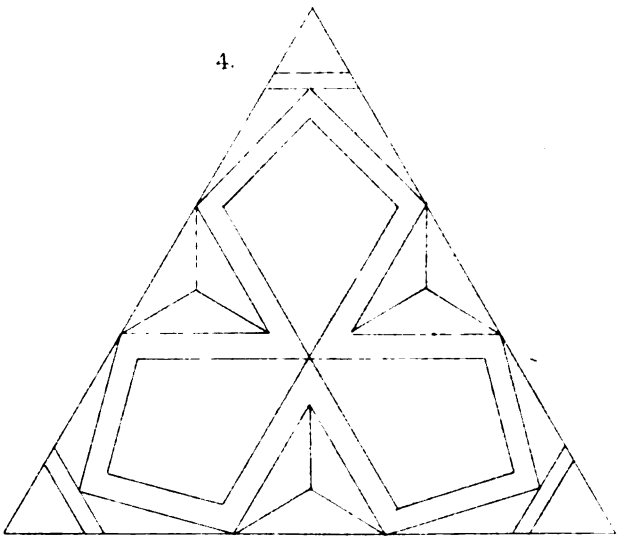

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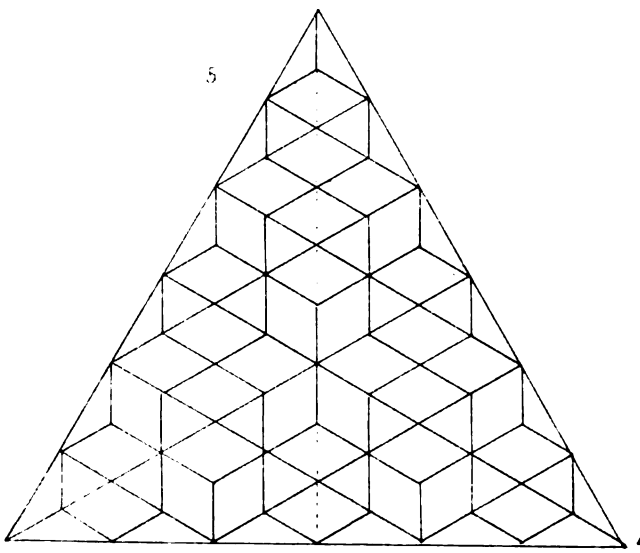

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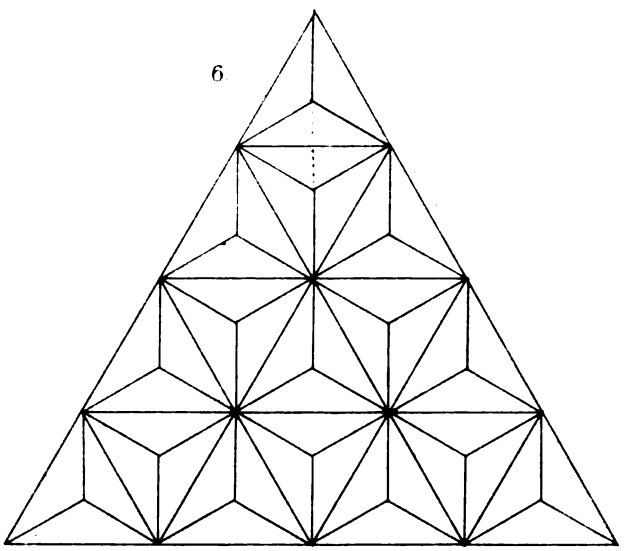

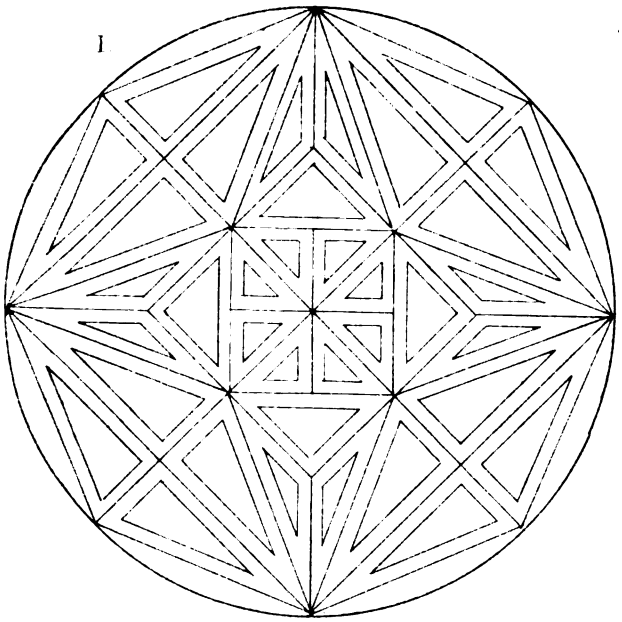
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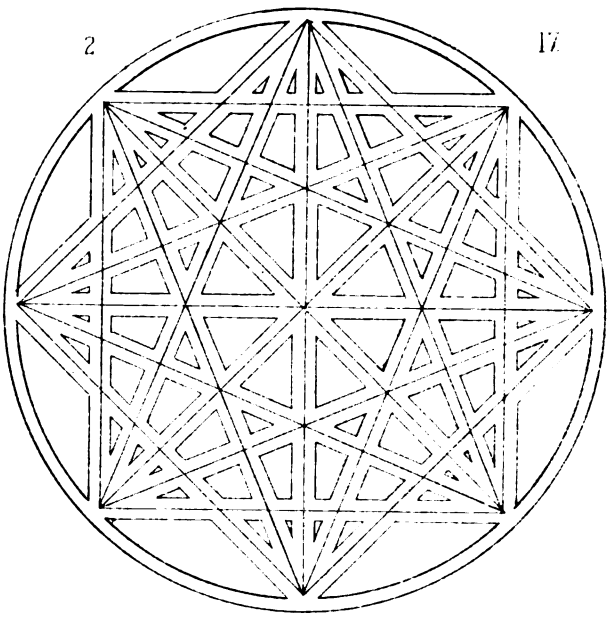
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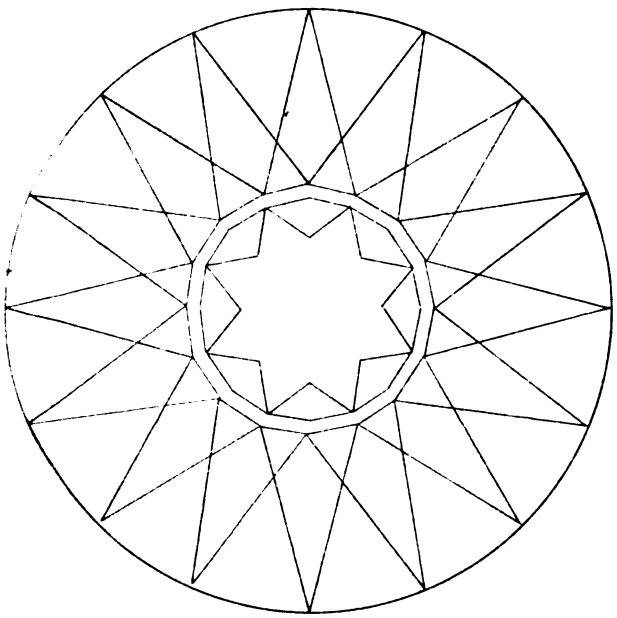

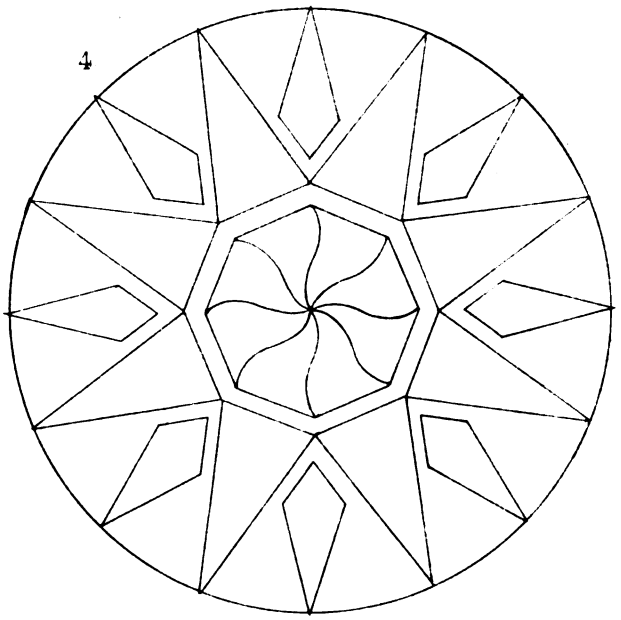
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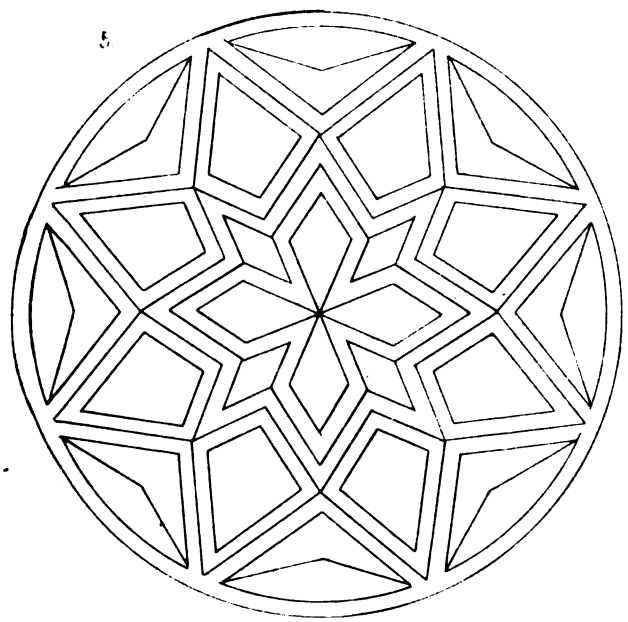
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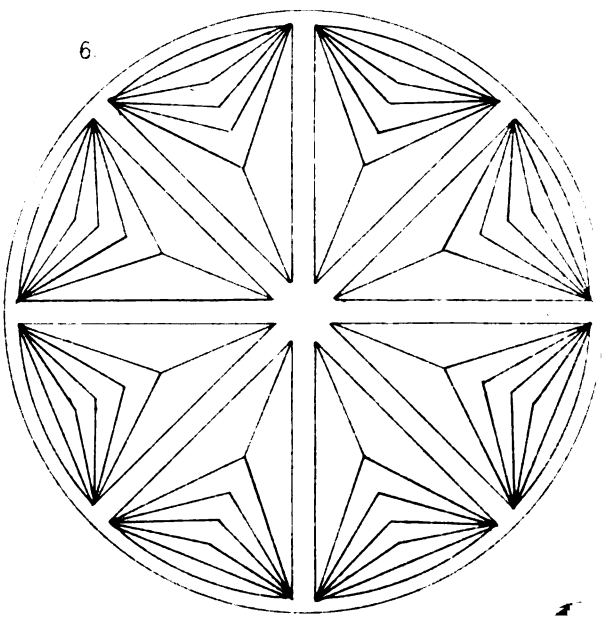
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PART VI.

DIVISION OF GEOMETRIC FIGURES BY RIGHT LINES AND CURVES.

PLATE.		LESSON.
18	Division of the square by right-lines and curves ... Nos. 1 to 6 inclusive	31
19	" " " " " " " " " applied to manufacture—Encaustic tiles..... " 1 to 6 "	32
20	Design for Diaper.	

In this part some little care will be necessary to prevent the pupils attempting too much. Let them proceed, as in Part V., to divide the square by the diagonals, in the same manner as in No. 1, plate 15; then bend these straight lines into a slight curve, returning again to the straight line, as is done in No. 4, plate 18. The sides of the square may also be curved. This should be done, at first, so as to produce a very simple figure when finished; something like No. 5, on plate 2, but with this difference, that the dotted lines should form a part of the design, and should be curved as directed above. This will have nearly the same effect as combining four of No. 1, plate 2; indeed, this method of combination may be adopted, for some time, in place of division, if the teacher think it best: the result will be nearly the same. The sides of the square may next be divided into any number of equal parts, as in No. 4, plate 18, and lines drawn from the centre to these points of division, and curved in one or more places, as the student may think best. By comparing No. 4 with No. 1, plate 18, it will be seen that they form nearly the same design. The latter, however, has the diagonals

drawn, and on each side of the lines which run through the centre there are additional lines, which are curved, in place of the central ones. The inner square of No. 2 is, again, but a repetition with the addition of a border of triangles. Nos. 5, 6, and 3 will form no difficulty when the others are understood.

The transition from this sheet to No. 19, which contains designs applicable to manufacture, is really so simple as scarcely to call for a remark. This will be apparent by comparing Nos. 1, 2, 5, and 6, plate 18, with Nos. 6 and 3, plate 19. There is no difficulty in the latter sheet which is not to be met with in the former. The whole of these designs, with no alteration whatever, are by boys under twelve years of age.

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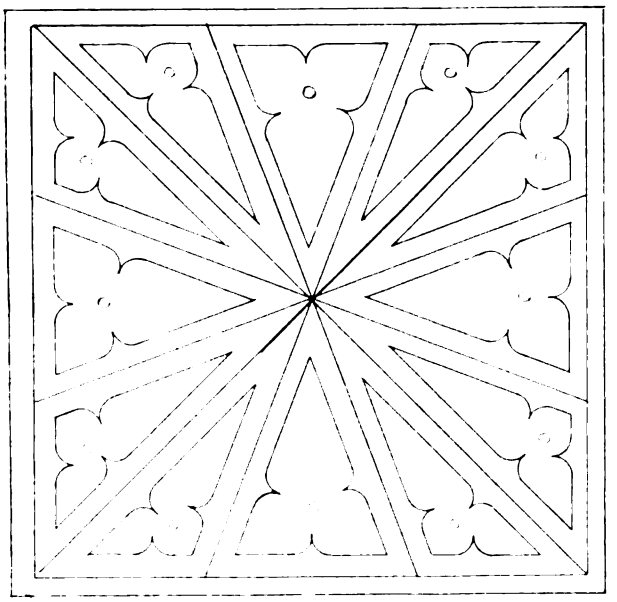

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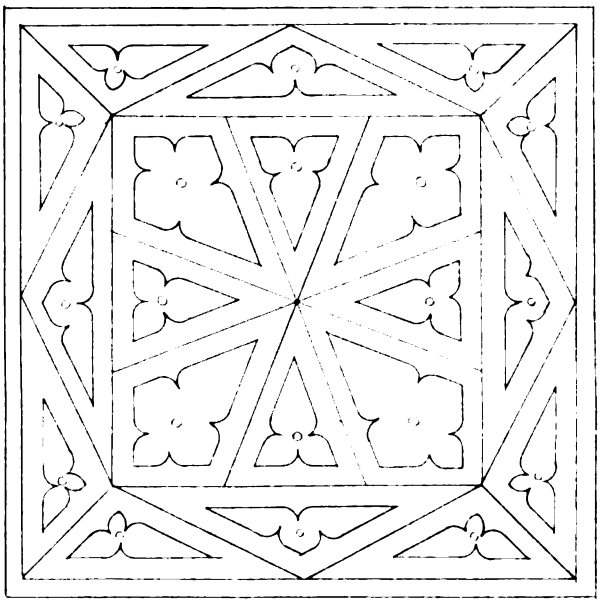

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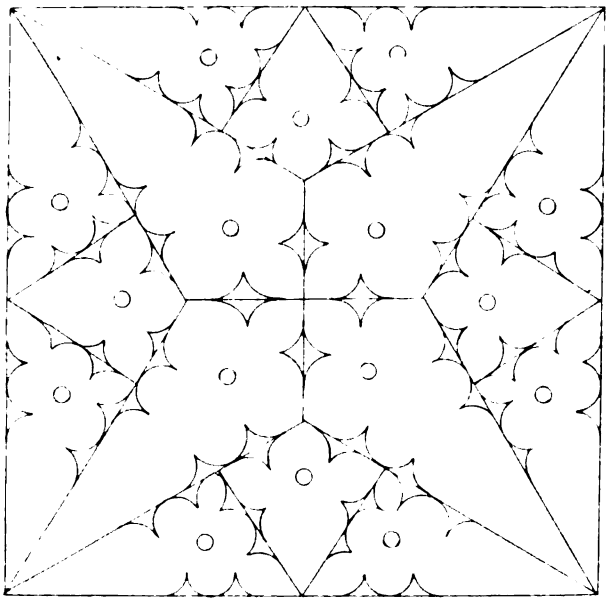

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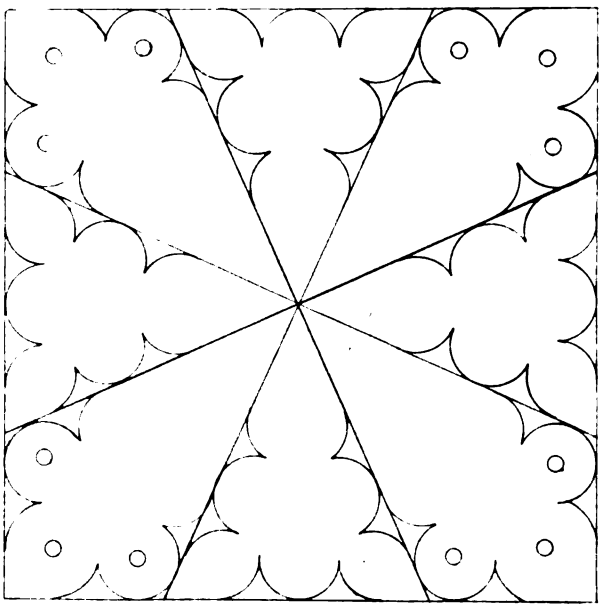

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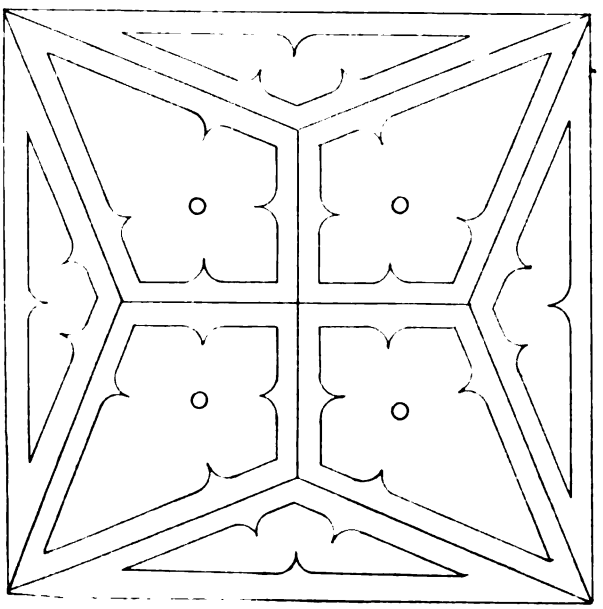

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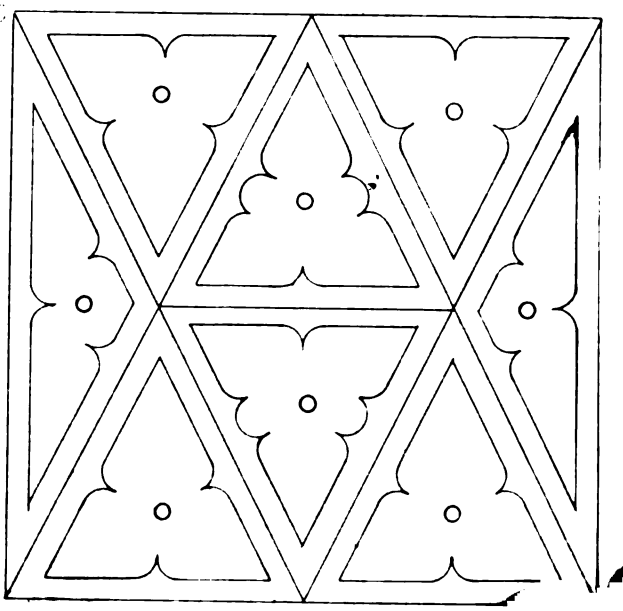

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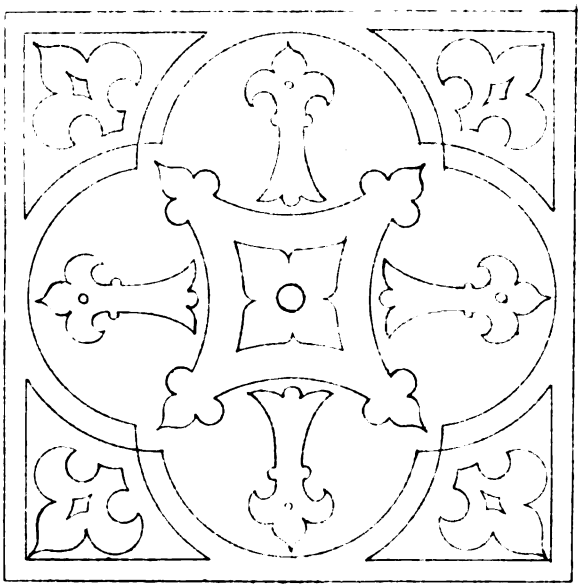

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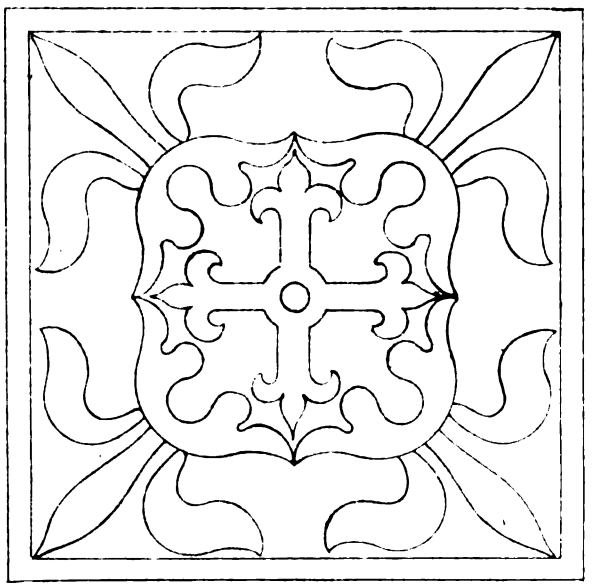

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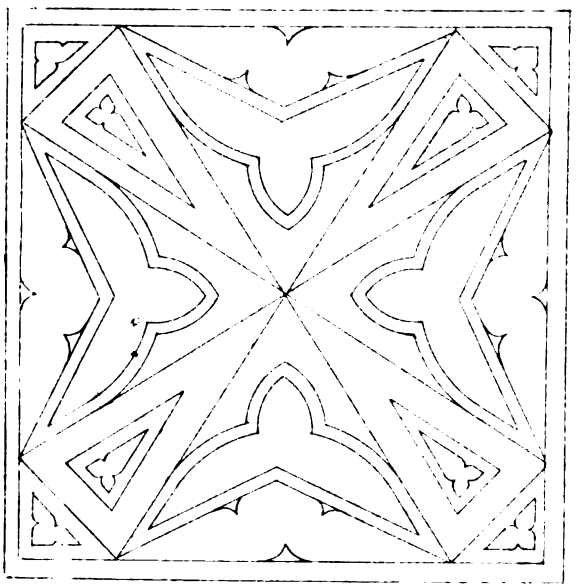

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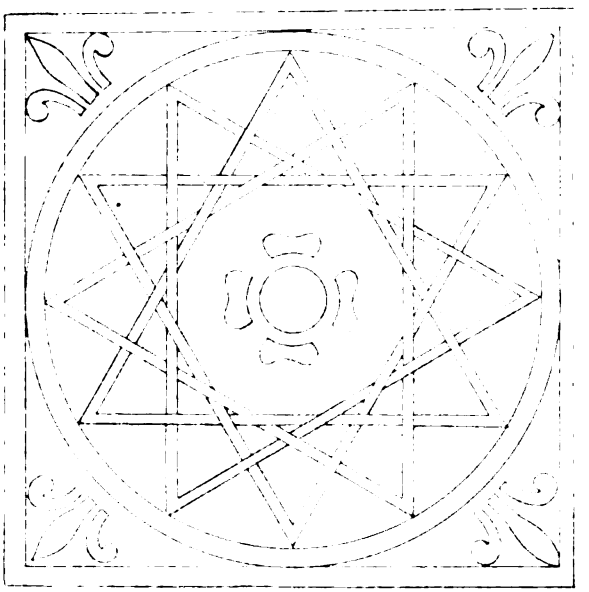

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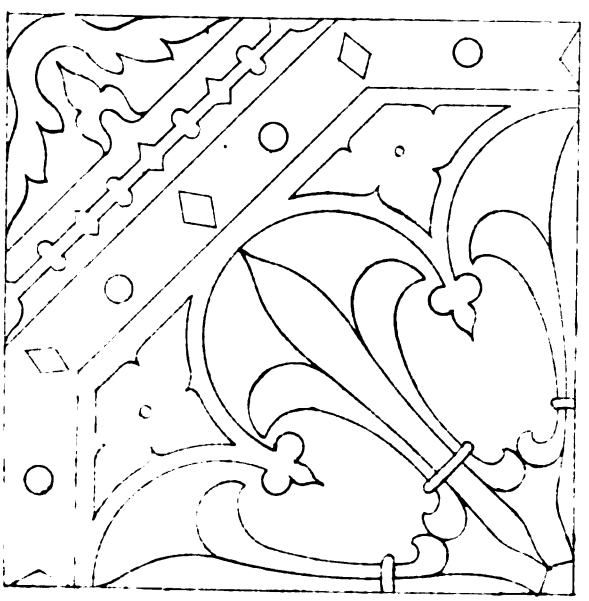

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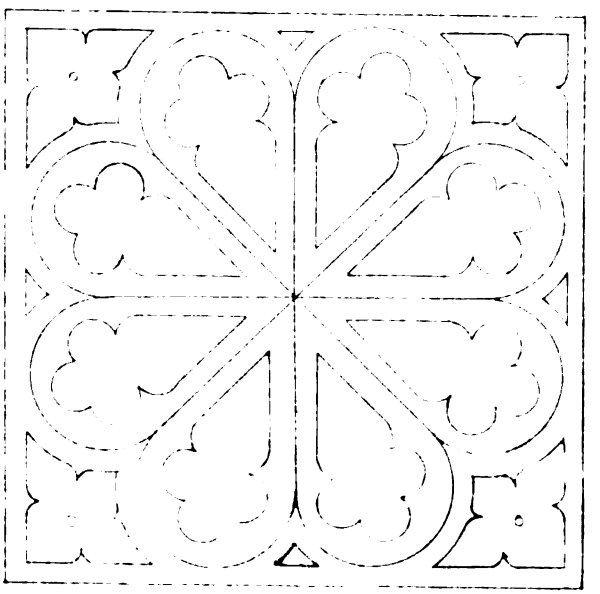
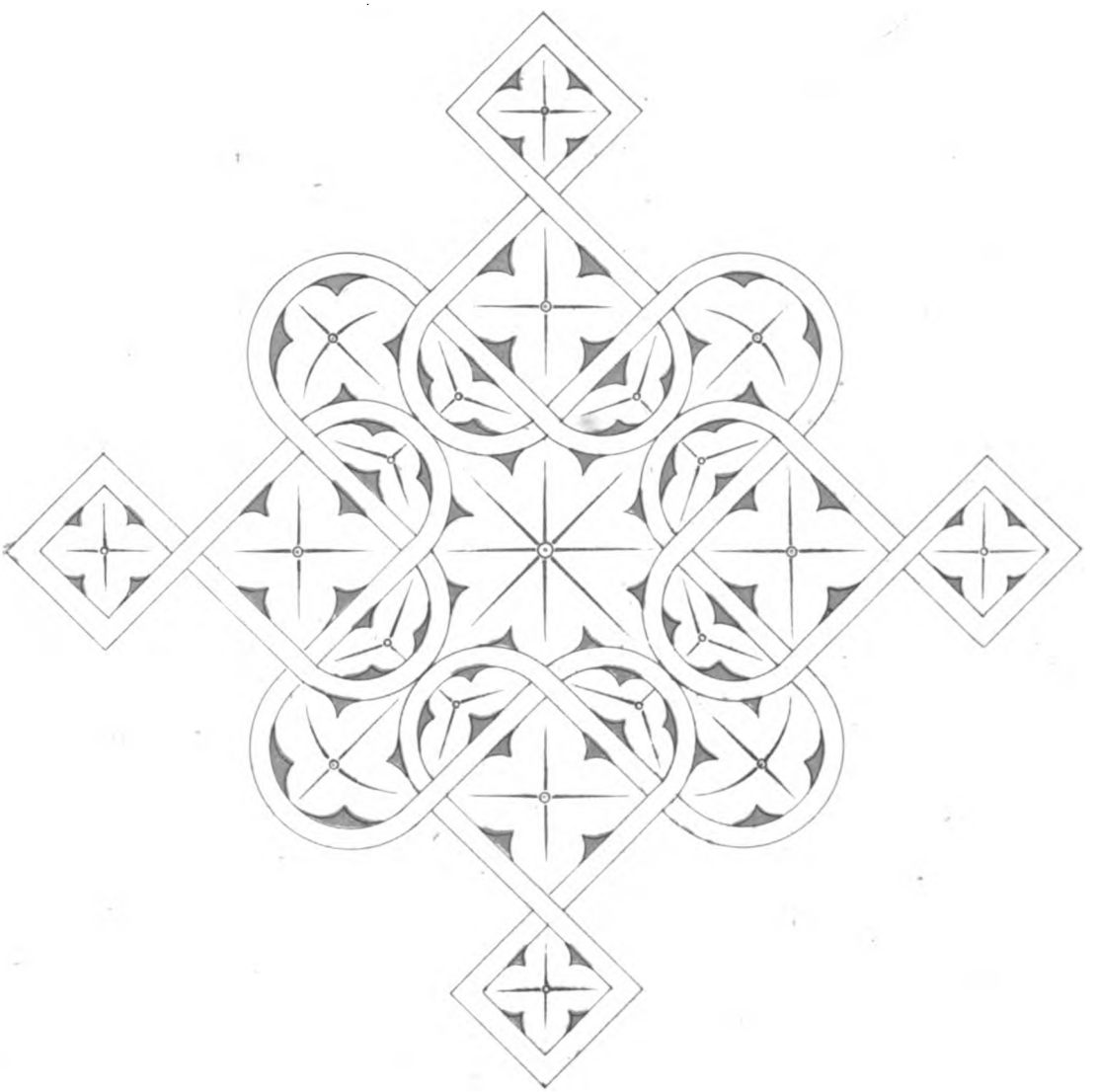




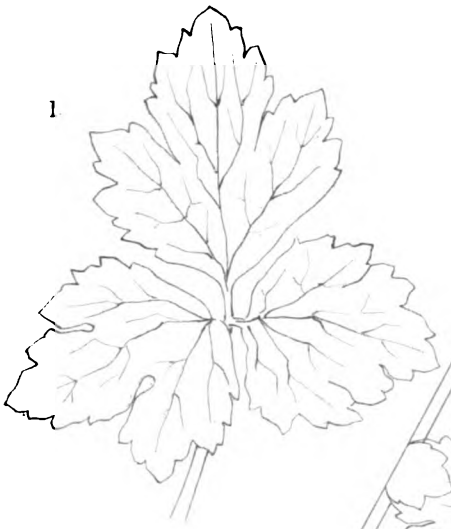
PART VII.

DESIGNS FROM NATURE; ILLUSTRATING THE USE OF THE ELEMENTARY AND COMPOUND FORMS IN DIAPERS.

PLATE.			LESSON.
21	Natural form of the leaf of the Buttercup	No. 1	33
	„ „ „ „ flower „ „	„ 2	„
	Design from the leaf and flower of the Buttercup (for skeleton form see plate 2, Nos. 2 and 25)	„ 3	„
	Design from the Crocus (see plate 2, No. 23)	„ 4	„
22	Heath, application of, to ornamental design (see plate 1, No. 19; plate 2, No. 26)	„ 1	34
	Buttercup leaf and flower, application of, to ornamental design	„ 2	„
	Wood Anemone, application of, to ornamental design (see plate 1, No. 23; plate 1, No. 14; plate 2, No. 8)	„ 3	„
23	Laburnum, or "Golden Rain," application of, to ornamental design (see plate 1, Nos. 24, 28, and 30)	Nos. 1 to 3 inclusive	35
	Hawthorn, application of, to ornamental design (see plate 1, No. 33; plate 2, No. 28)	No. 4	„
24	Cowslip, design from, (see plate 2, No. 24)		36
25	Horse-chestnut, design from, (see plate 1, No. 45)	No. 1	37
	Oak, leaf and fruit, design from, (see plate 1, No. 38)	„ 2	„
26	Ranunculus, design from, (see plate 1, No. 37)	„ 1	38
	Wild Strawberry, design from, (see plate 2, No. 27)	„ 2	„
27	Jessamine, application of, to design	„ 1	39
	Fern and Harebell, design from, (see plate 1, Nos. 19 and 35)	„ 2	„
28	Wild Pimpernel, design for border for paper hanging (see plate 1, Nos. 17 and 35)	„ 1	40
	Paris Quadrafolia, design for paper hanging (see plate 1, No. 19)	„ 2	„
29	Application of elementary forms on plates 1 and 2 to solid forms	Nos. 1 to 5 inclusive	41
30	The Passion-flower, design for goblet in glass or silver		42

Great as the gap may *seem* between this and the previous part, there is really little difference; the same principle of division, laid

down in Part V., is here carried out. Take, as the first example, No. 4, plate 21: this will be found to be the square divided, as in No. 23, plate 1, by lines bisecting the sides, and again by its diagonals. These lines are taken as the division of the figure for the arrangement of the complete design, and form the main stems of the leaves or flower, as the case may be. No. 23, plate 2, gives the skeleton form for this. The developement of the curve from the right line is here found in the flower itself, the outside edges of which are seen thrown out from the lines bisecting the square. The same thing is done with the diagonals; but in this case the flower is varied, by being given in a less forward state of growth. The leaves are then arranged as subordinates around the flower, almost in the manner of their growth. The division of the triangle, No. 3, plate 21, still shows the same simple division, and the flowers grouped according to the direction of the bisecting lines. It will be well to draw the parts of the flowers, leaves, &c., as given in Nos. 1 and 2, plate 21, for the sake of practice in drawing from nature, and in order to become familiar with the form of the plant, so as to see in what manner it may be best adapted to the purposes of design. The elementary forms of six of these designs from nature are given on plate 2, Nos. 23 to 28, which will be of great assistance to the student, in pointing out the general groundwork of the whole.



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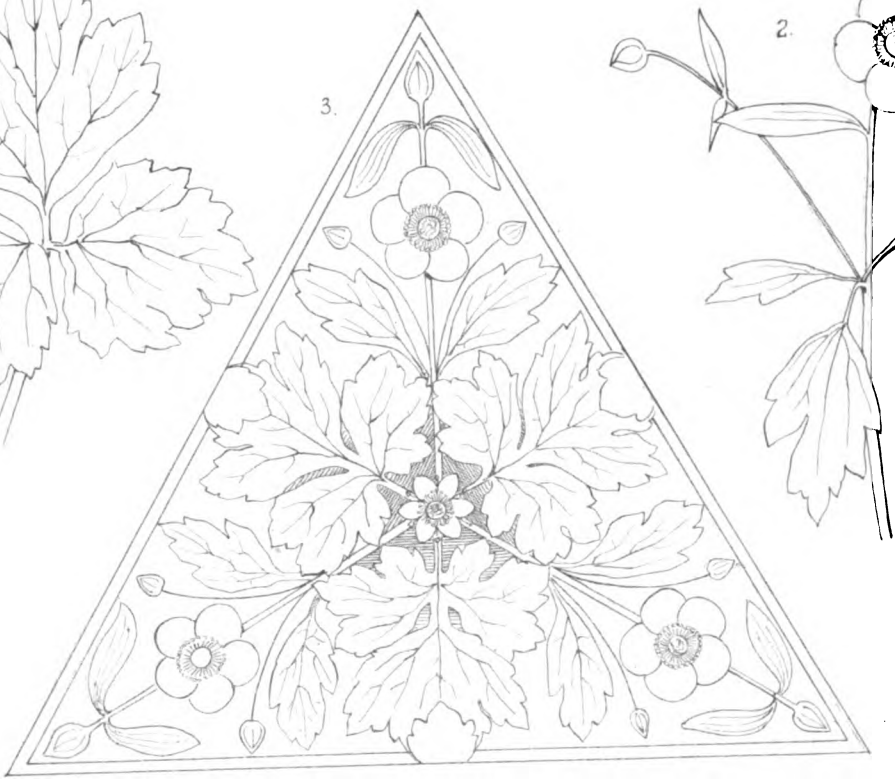

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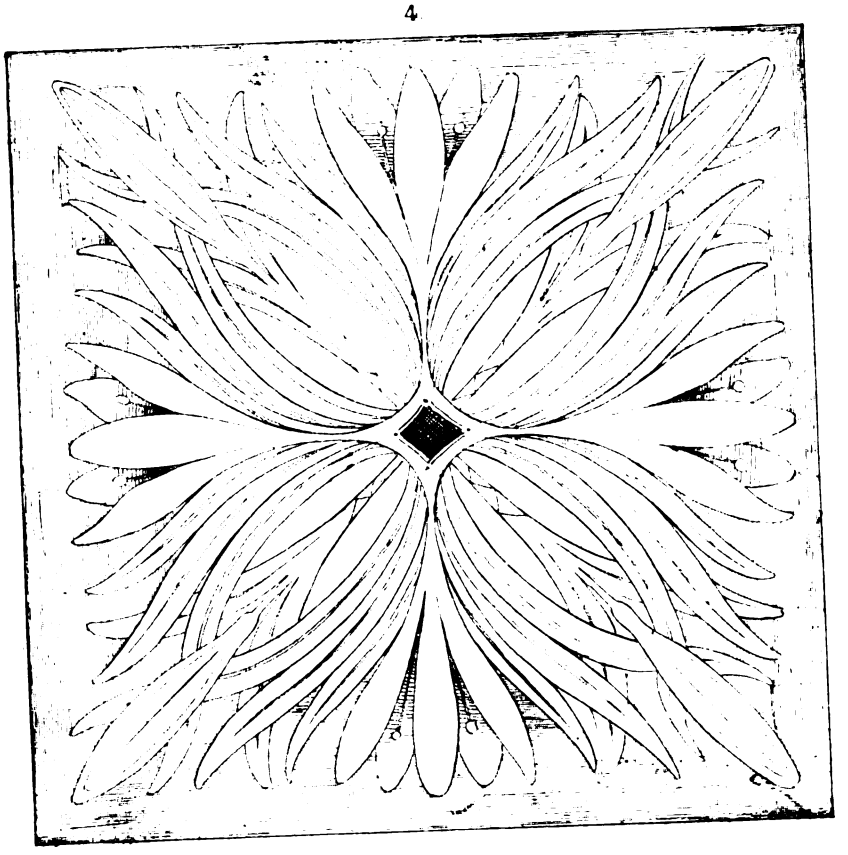

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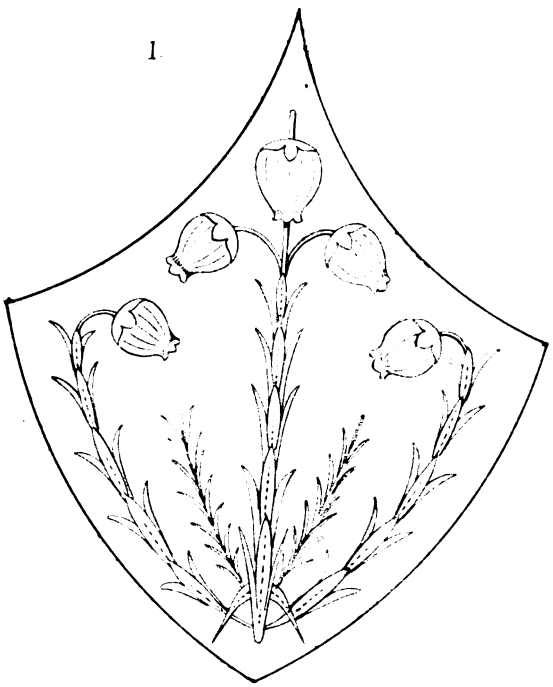

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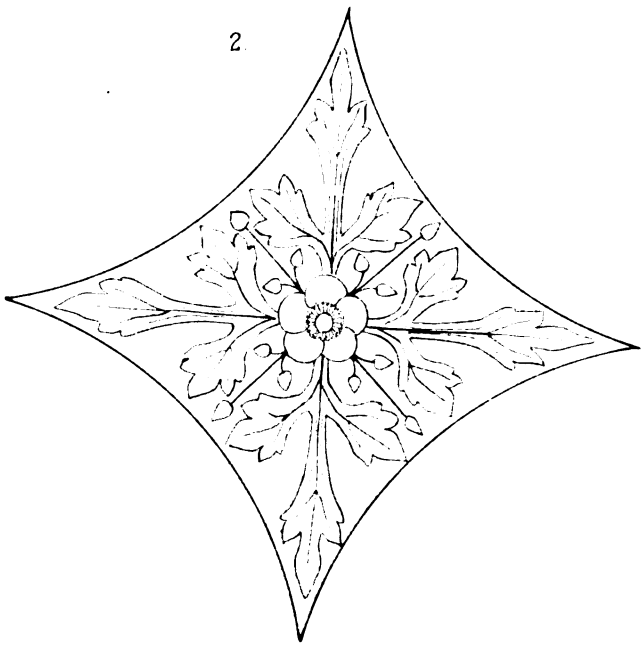

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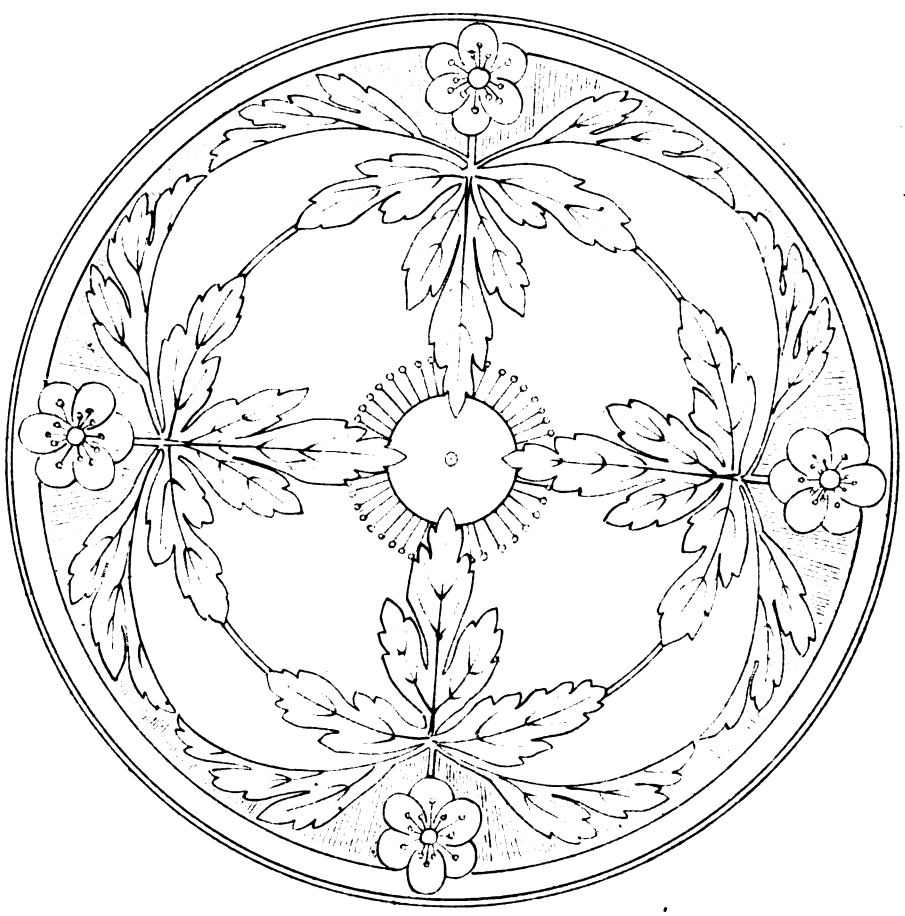

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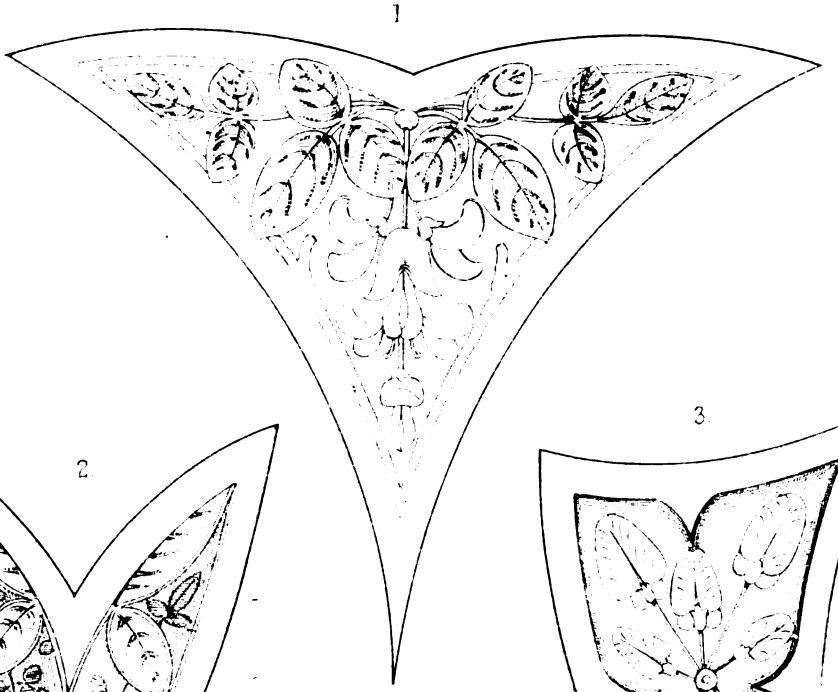

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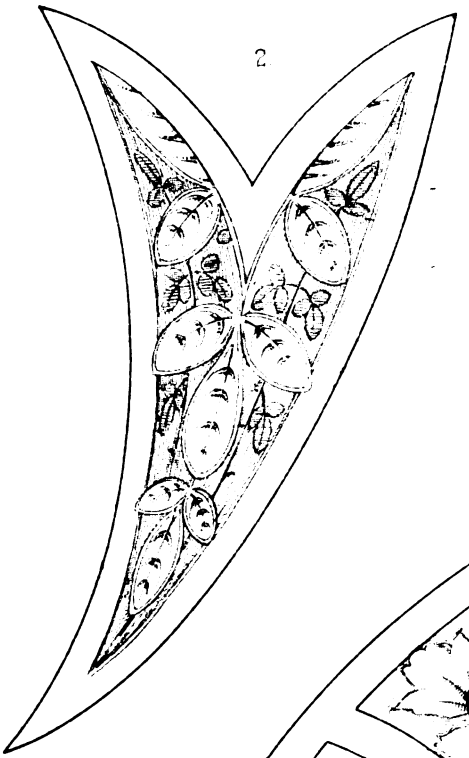

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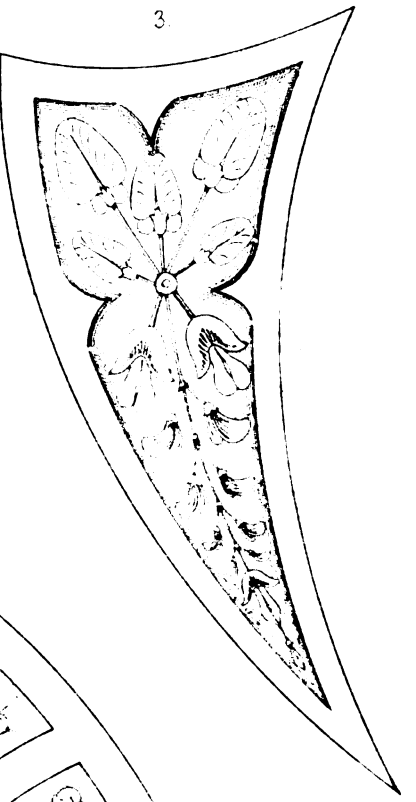

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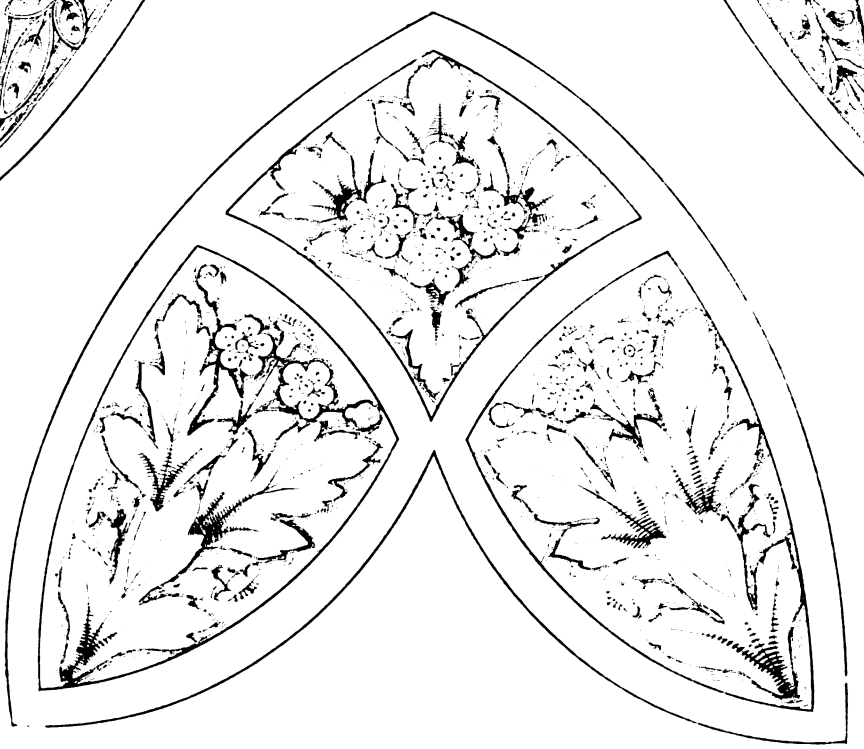

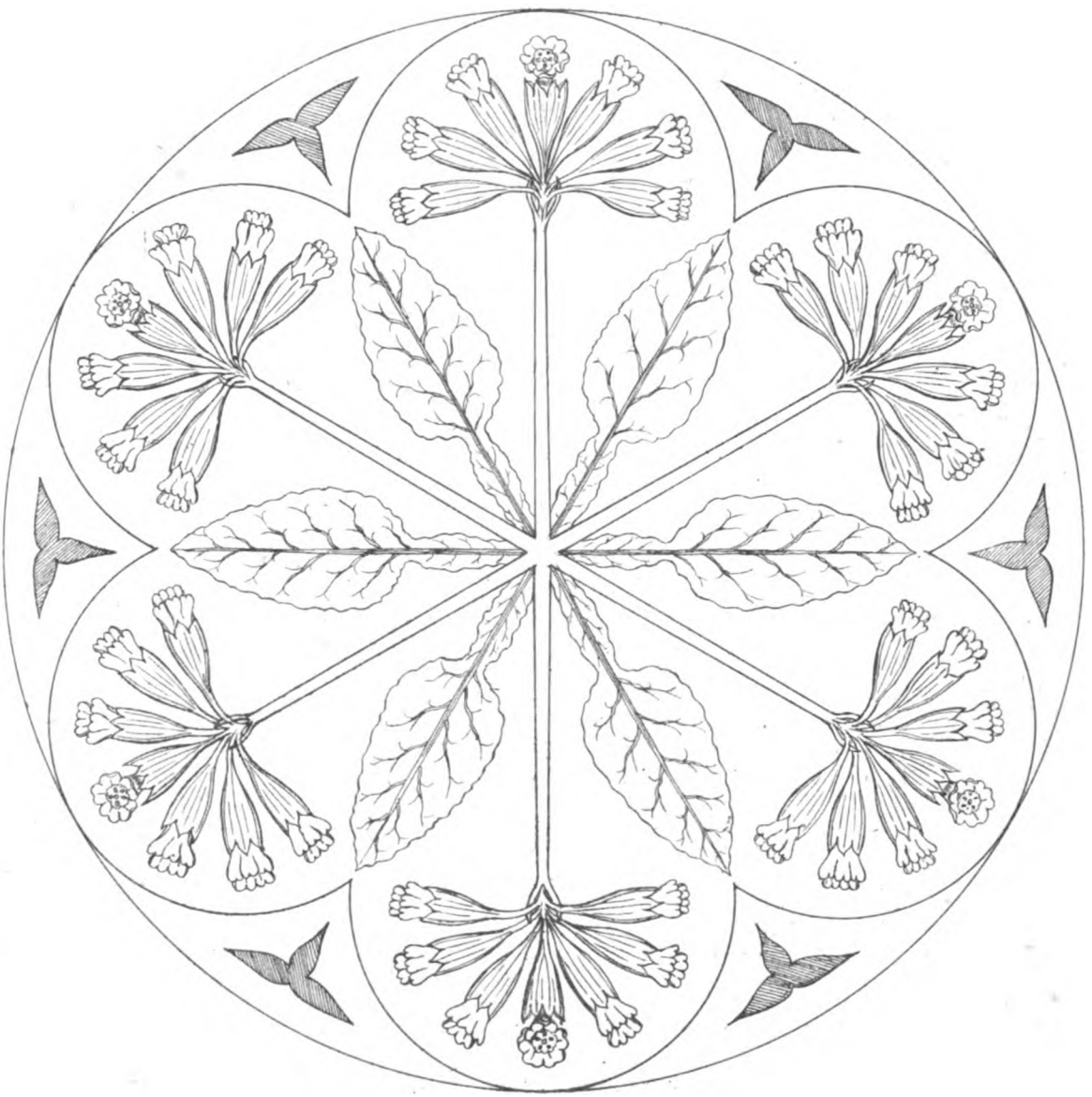

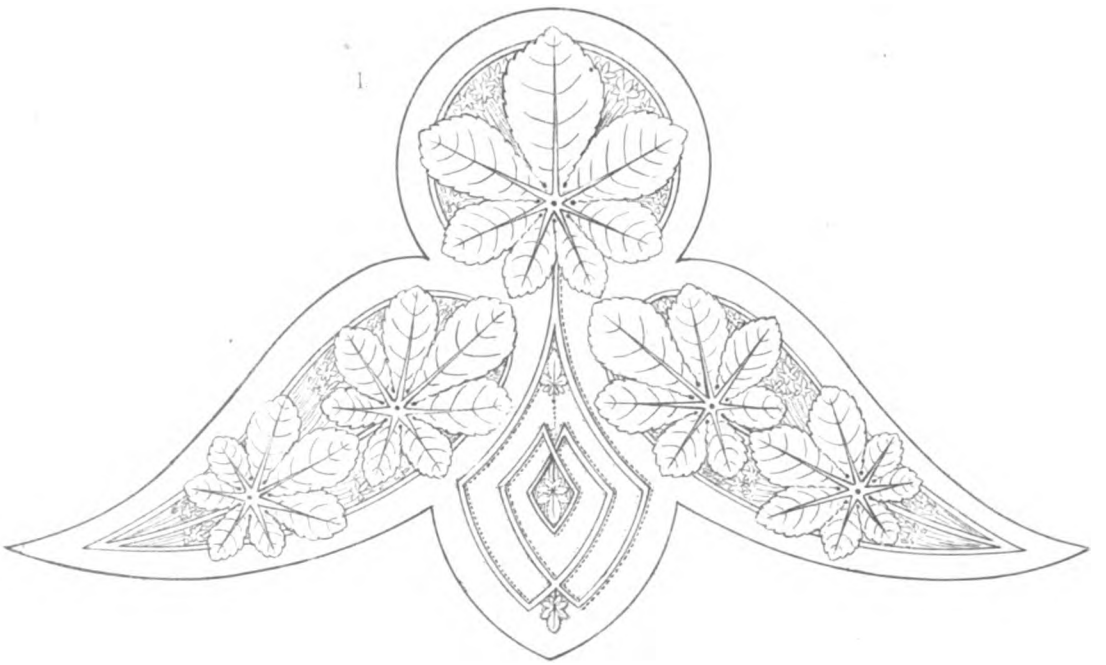

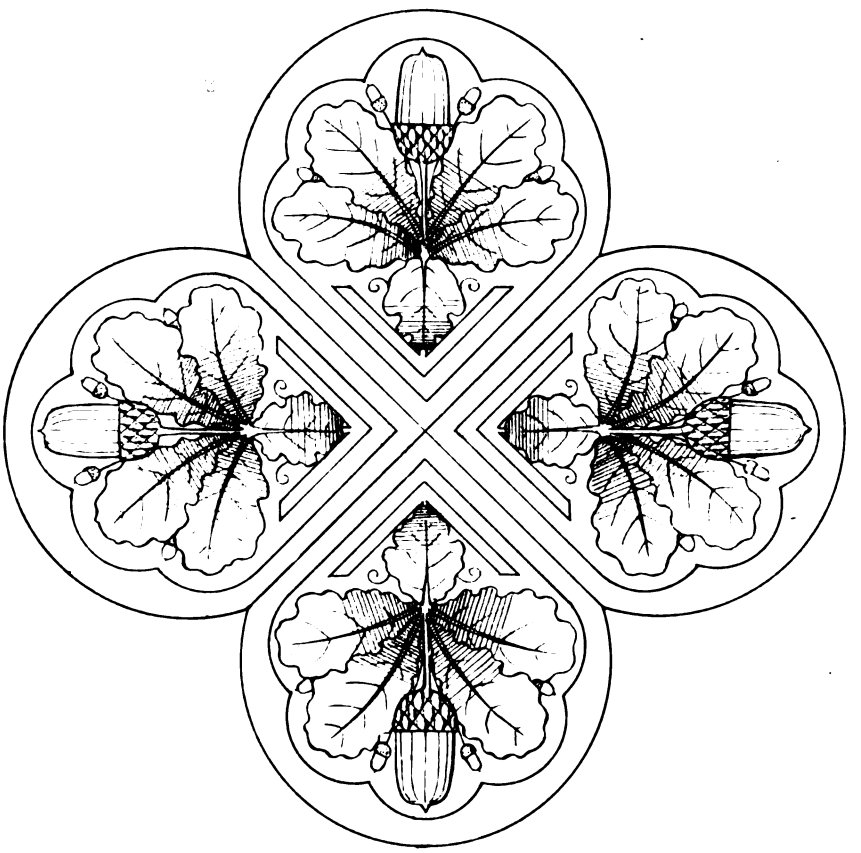

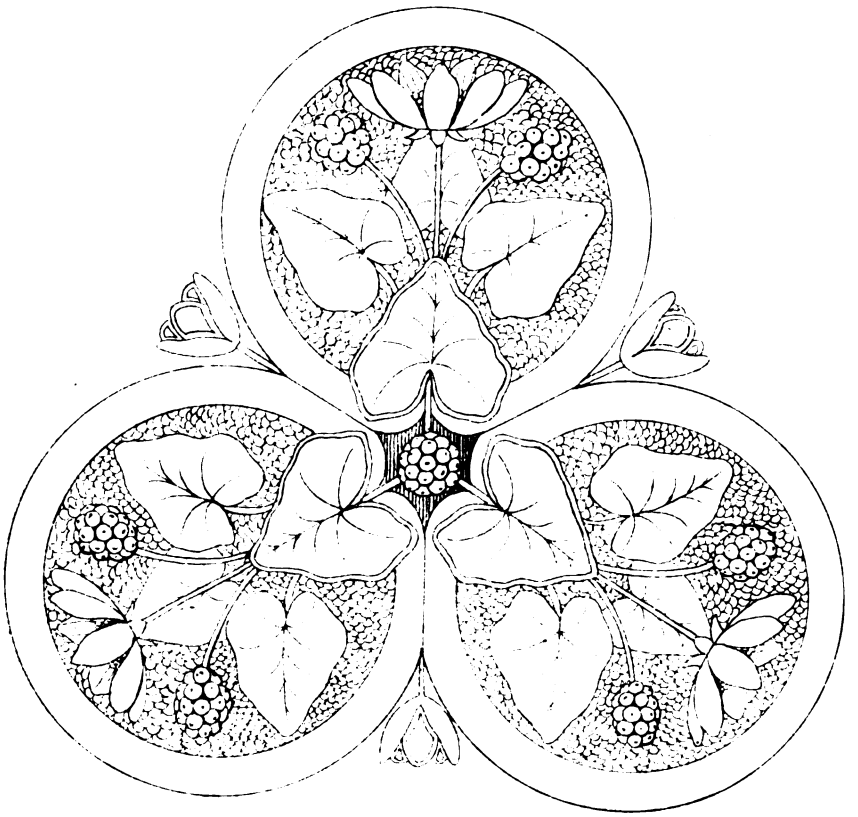

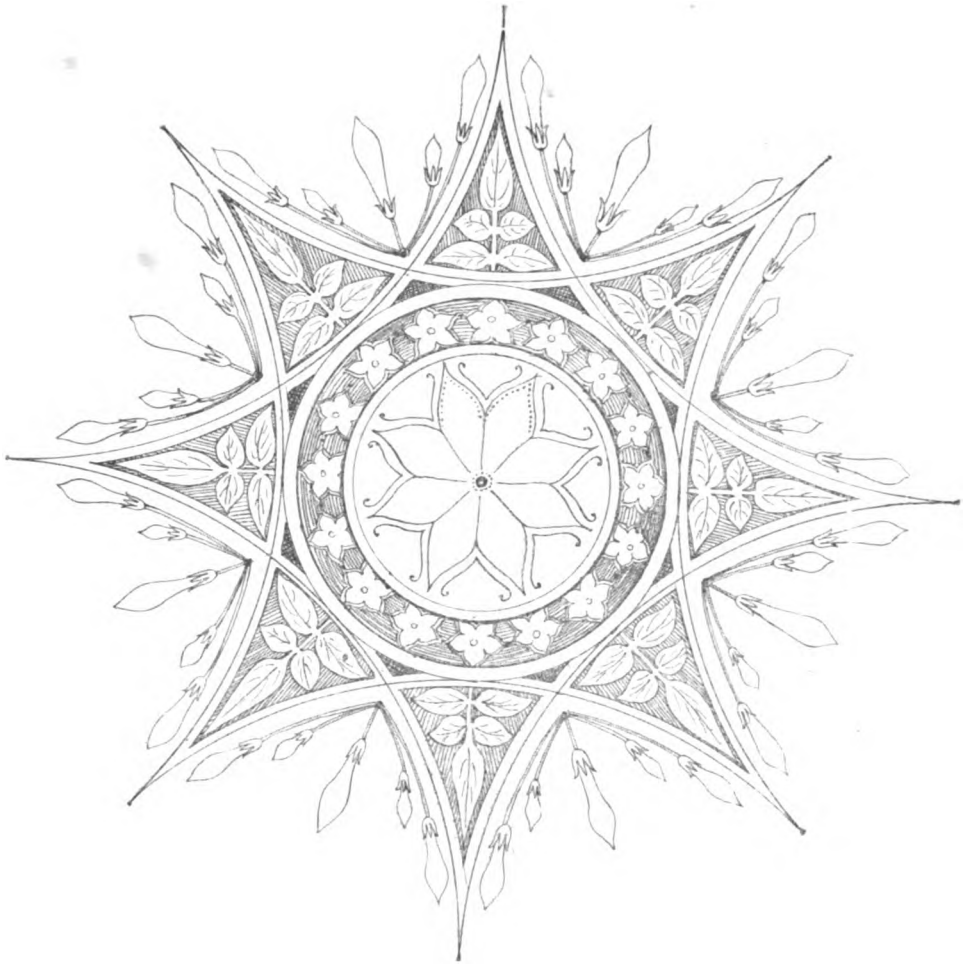

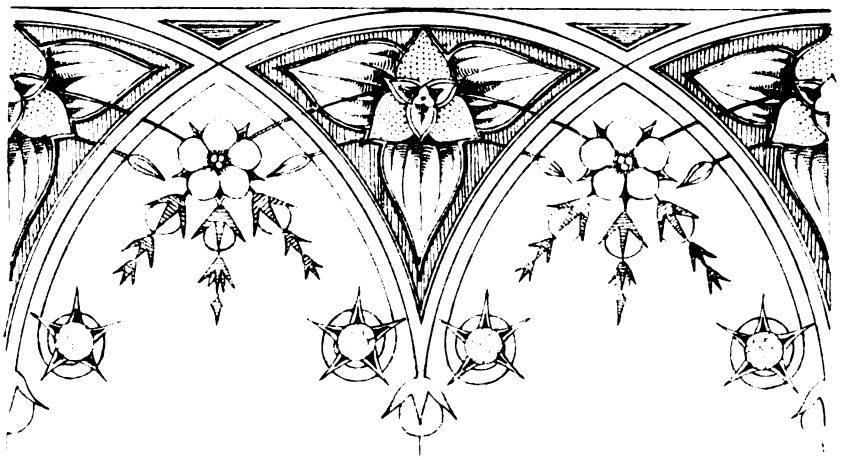

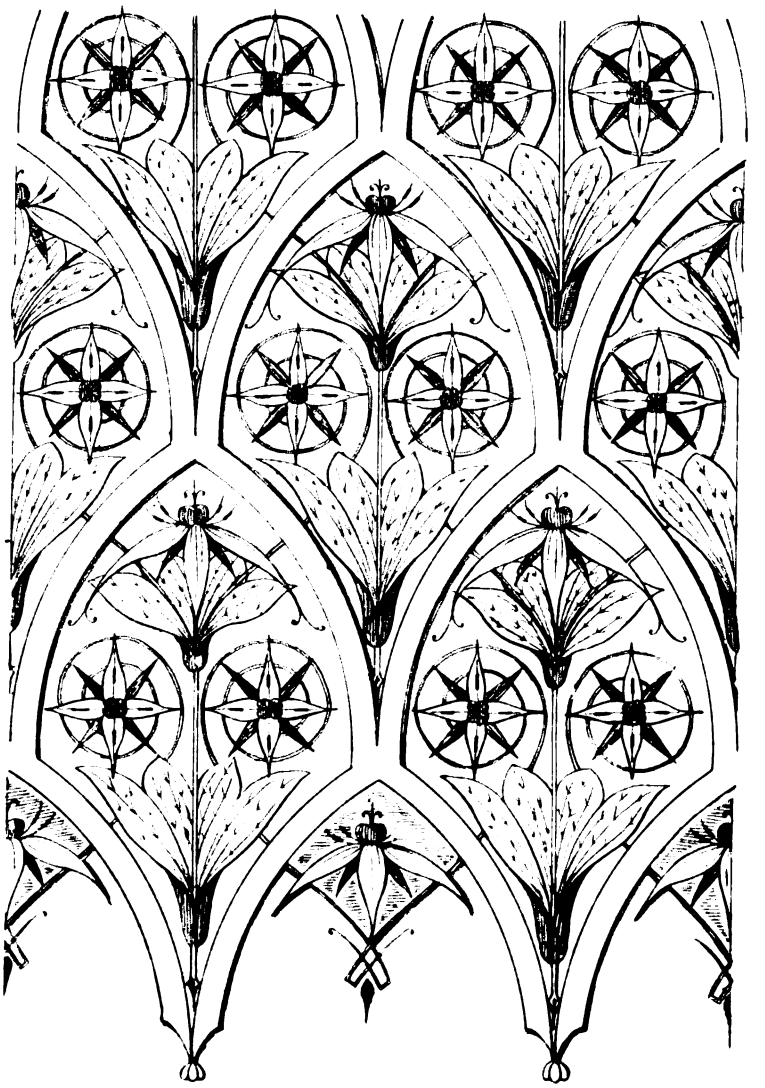

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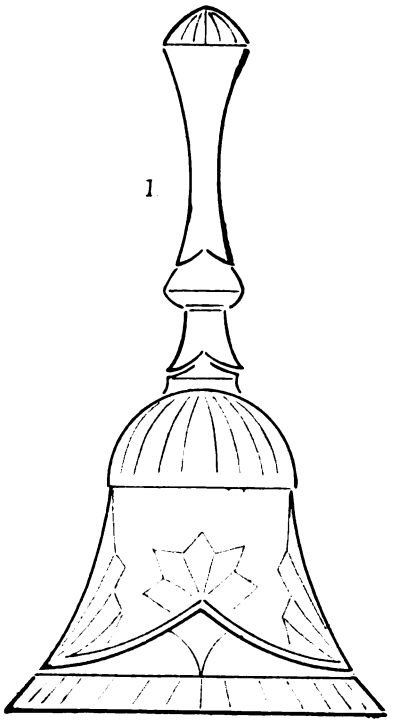

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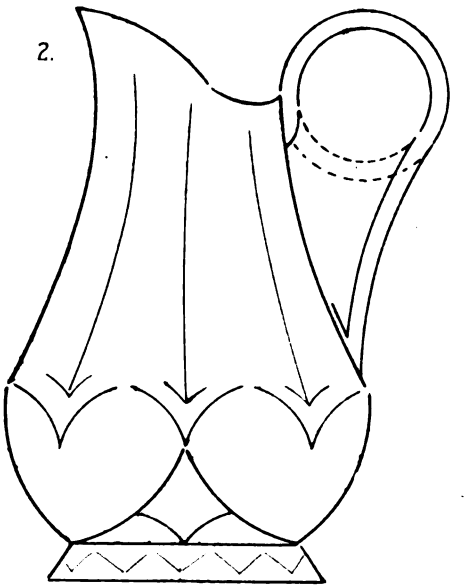

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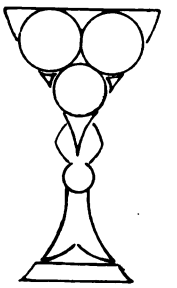

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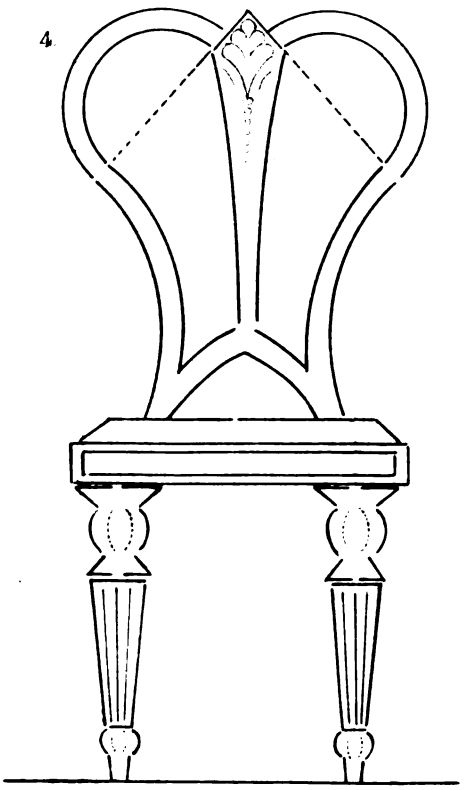

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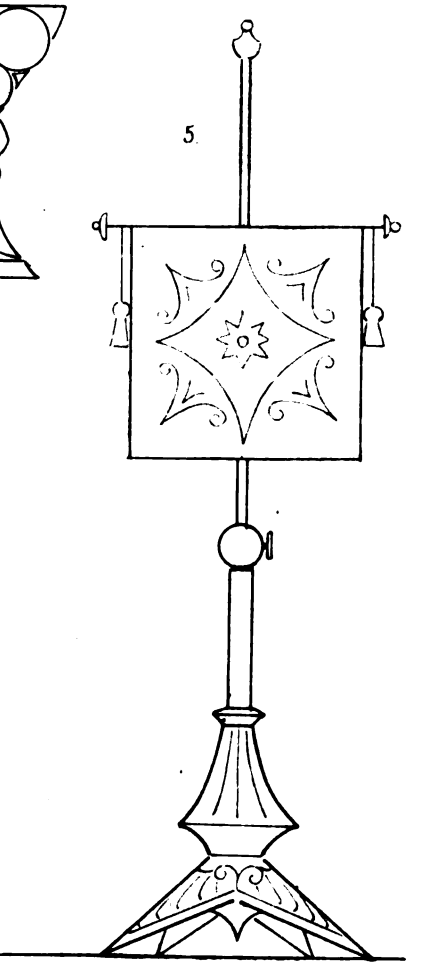
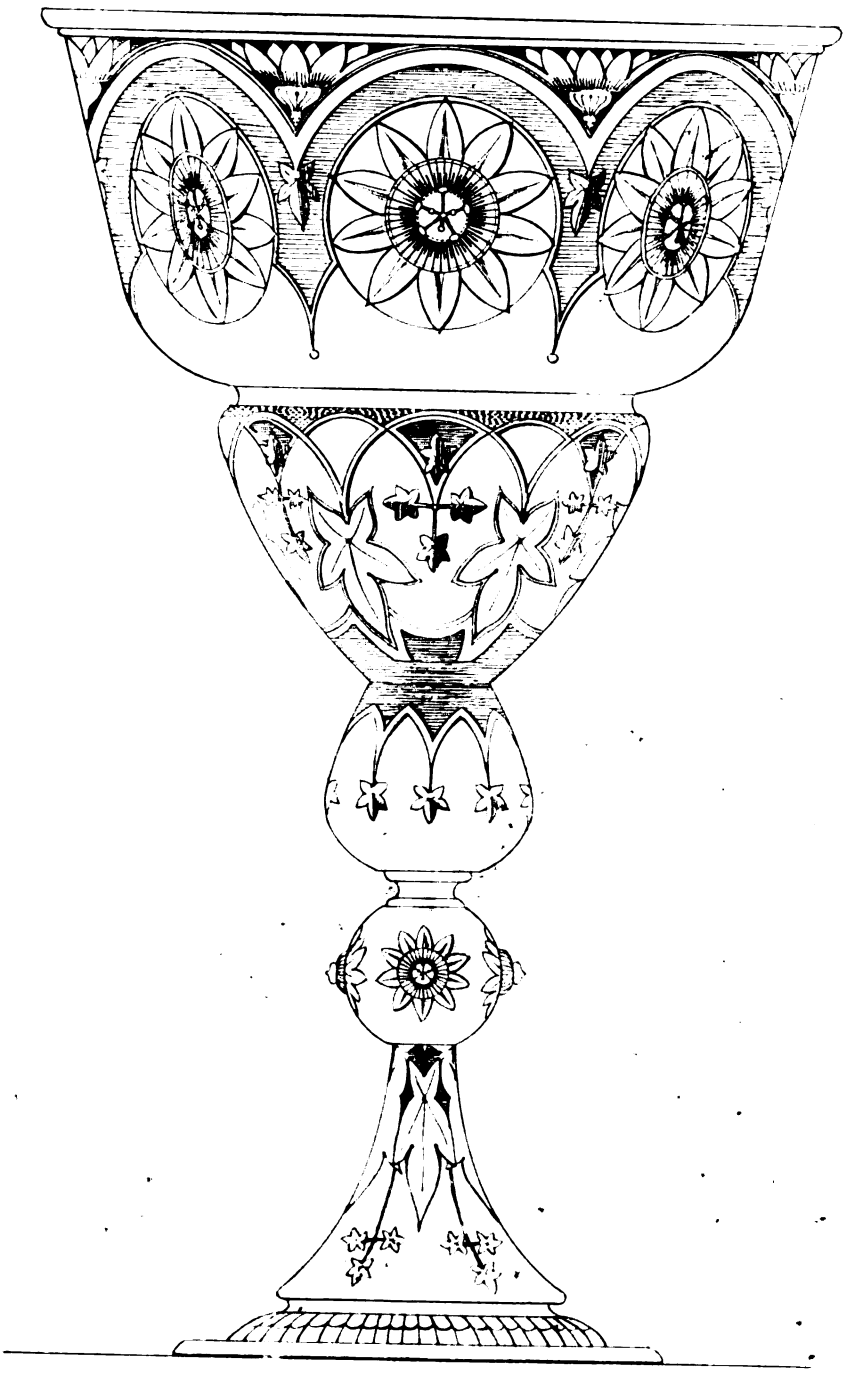




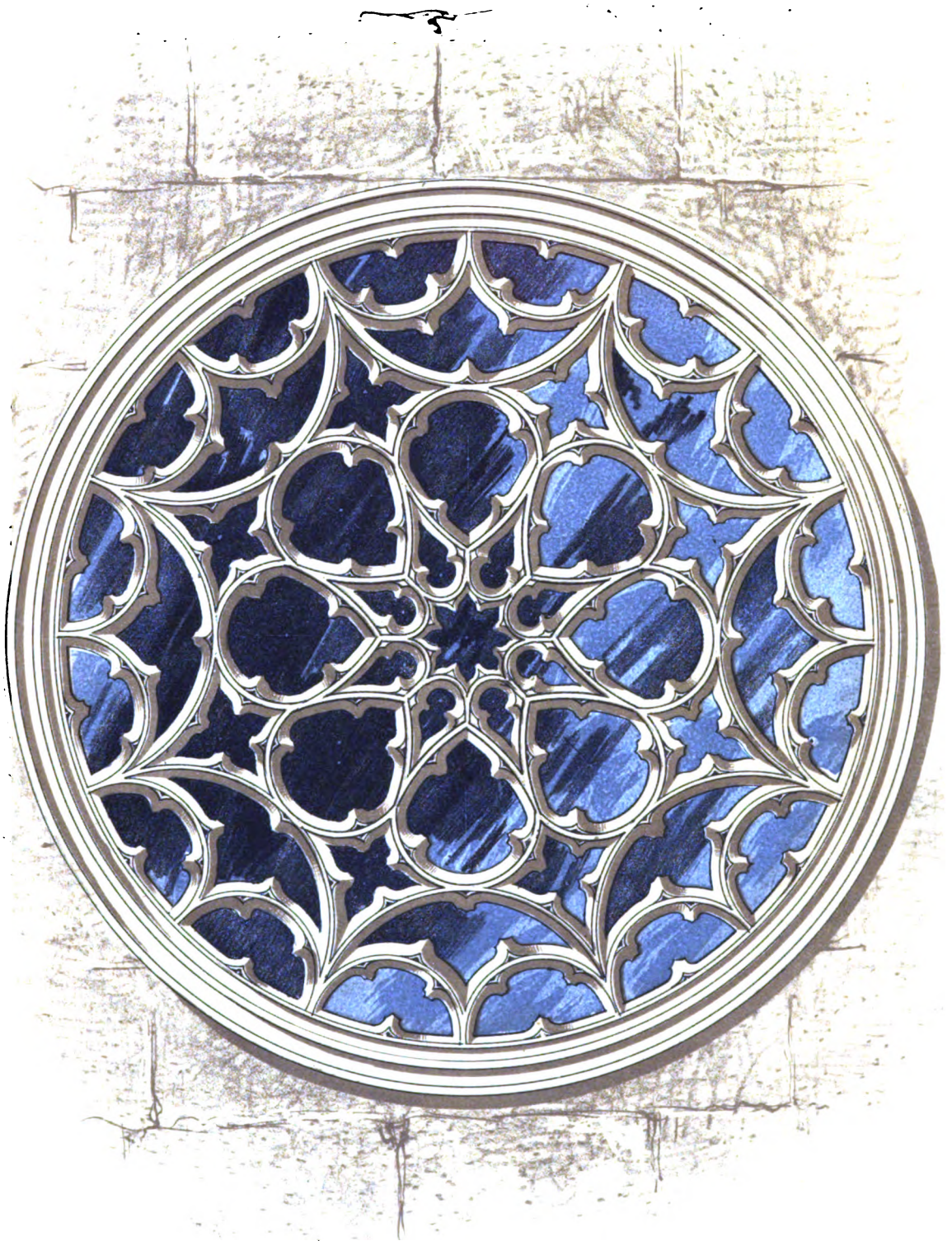
PART VIII.

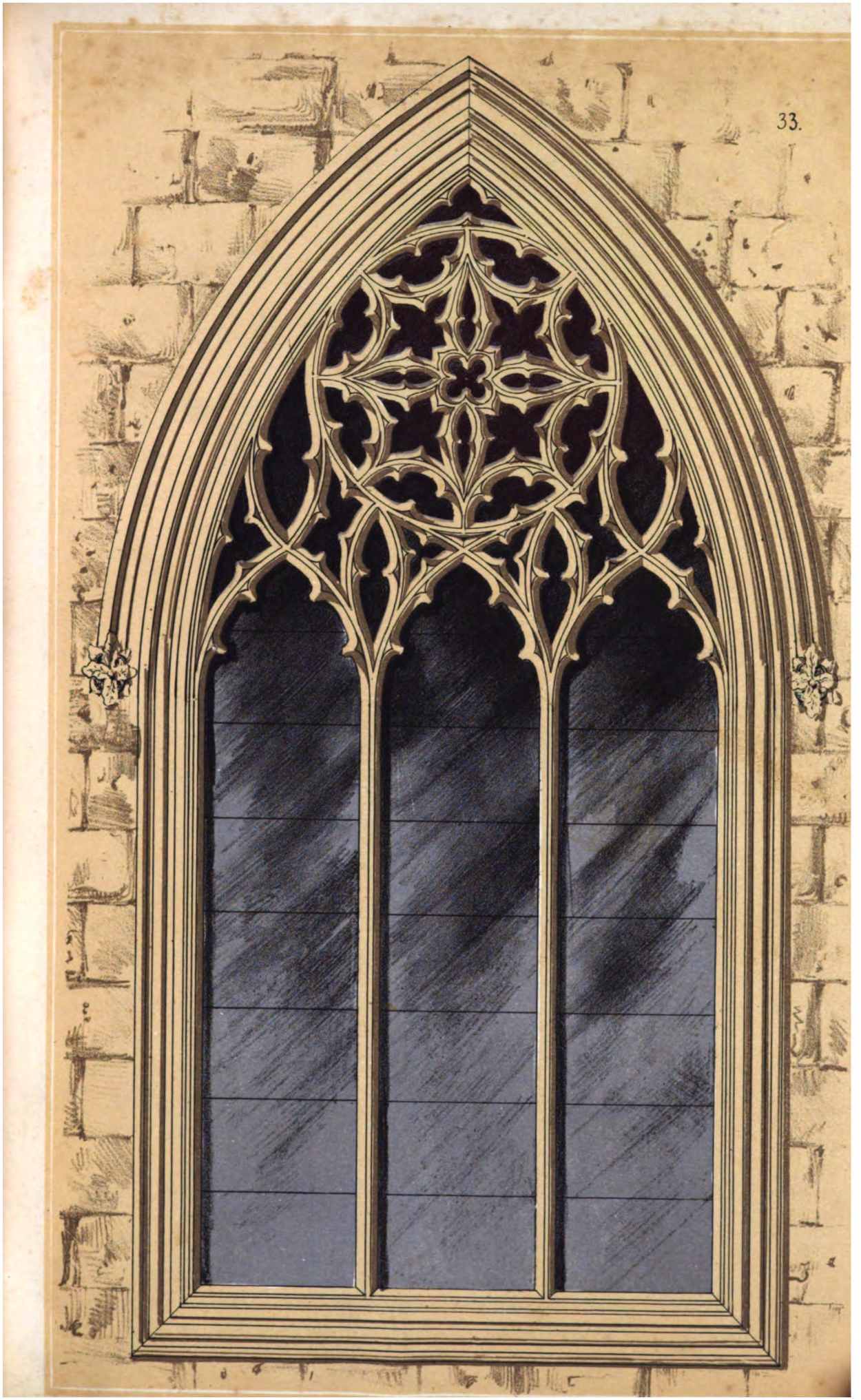
PART VIII.

Plate.		Lesson.
31, 32, 33, 34	Designs for windows, in stone or iron	43
35	"Title-page," Wild Strawberry.	

The four plates comprised in this part are not given as specimens of pure architecture, but simply to show how much may be done with one line slightly varied. Most of the lines in these windows will be found to be simply the repetition of a semicircle. This will be a most interesting part of the work; as almost any form may be chosen for the groundwork, and the pupils left to finish them in their own way. Even the skeleton form of the design from the cowslip, plate 24, (see No. 24, plate 2,) may be taken for a diagram on which to base designs for windows, iron gratings, &c., and may be varied in almost athousand ways.

Designs of this class will have the effect of calling the attention of town boys to the architecture around them, while the designs from flowers will have the merit of awakening the thoughts and attention of town and country lads; in both cases the effect may be to give a little more of that grace and culture which is the crowning ornament of all true education.





DEFINITIONS.

LINES.

A LINE is length without breadth.

A RIGHT LINE is that which lies evenly between its extreme points: it has length, but not breadth.

A POINT is that which has no parts or magnitude.

A PLANE RECTILINEAL ANGLE is the inclination of two straight lines to each other, which meet together, but are not in the same straight line. (Plate 1, Nos. 1, 2, 3.)

A RIGHT ANGLE.—When a straight line standing on another straight line makes the adjacent angles equal to each other, each of these angles is called a right angle; and the straight line which stands upon the other is called a PERPENDICULAR to it.

AN ACUTE ANGLE is that which is less than a right angle.

AN OBTUSE ANGLE is that which is greater than a right angle.

A RECTILINEAL FIGURE is that which is enclosed by straight lines. "Two straight lines cannot enclose a space."—EUCLID: B. 1, Def. XX., Ax. 10.

A TRIANGLE is a three-sided (trilateral) figure. (Plate 1, Nos. 4, 5, 6.)

A RIGHT-ANGLED TRIANGLE is that which has a right angle. (Plate 1, No. 4.)

AN ACUTE-ANGLED TRIANGLE is that which has three acute angles. (Plate 1, No. 5.)

AN OBTUSE-ANGLED TRIANGLE is that which has an obtuse angle. (Plate 1, No. 6.)

A PARALLELOGRAM is a four-sided figure of which the opposite sides are equal and parallel; its opposite angles are also equal—(EUCLID: B. 1, Pr. 34)—and the diameter or the diagonal is the straight line joining two of its opposite angles. (Plate 1, Nos. 7, 8, 9, 10, &c.)

AN OBLONG is a four-sided figure, which has all its angles right-angles, and its opposite sides equal and parallel. (Plate 1, No. 8.)

A SQUARE is a four-sided figure having all its sides equal and all its angles right angles. (EUCLID: B. 1., Def. XXX. Plate 1, Nos. 9, 10.)

A RHOMBUS is a figure which has all its sides equal, but its angles are not right-angles. (Plate 8, No. 3.)

A RHOMBOID is a figure which has its opposite sides equal to each other, but all its sides are not equal, nor its angles right angles.

Note.—All other four-sided figures are called TRAPEZIUMS.

CURVES.

A CIRCLE is a plane figure contained by one line, which is called the circumference, and is such that all straight lines drawn from a certain point within the figure to the circumference are equal to one another. The lines so drawn are called radii, and this point is called the centre. (EUCLID: B. 1, Def. XV. Plate 1, No. 14.)

A SEMICIRCLE is the figure contained by a diameter of a circle and the part of the circumference cut off by it. (Plate 1, No. 15.)

A CURVE is a line continually changing its direction.

A CURVILINEAR ANGLE is the inclination of two curve lines to each other which meet together, but are not in the same curved line. (Plate 1, Nos. 16, 17, and 18.)

A CURVILINEAR FIGURE is that which is contained by curved lines. Two curved lines (or one in the case of the circle) may enclose a space. (Plate 1, Nos. 19 to 45.)

A CONVEX ANGLE* is the inclination of two curved lines with their convex edges towards each other. (Plate 1, No. 16.)

A CONCAVE ANGLE* is the inclination of two curved lines with their concave edges towards each other. (Plate 1, No. 17.)

A MIXED ANGLE is the inclination of two curved lines, the one with its convex edge and the other with its concave edge towards each other. (Plate 1, No. 19.)

A TREFOIL is so called from its resemblance to the three-leaved plants, such as the Clover and Wood Sorrel. (Plate 1, No. 37.)

A QUATREFOIL is so called from its resemblance to four leaves. (Plate 1, No. 38.)

A DIAGONAL is a line drawn from angle to angle.

* The inside of the rind of an orange is *concave;* the outside is *convex.*

THOMAS UNDERWOOD, PRINTER AND LITHOGRAPHER,
CASTLE STREET, HIGH STREET, BIRMINGHAM